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November 9, 2011

VIA COURIER, EMAIL, RESS

Ms. Kirsten Walli
Board Secretary
Ontario Energy Board
2300 Yonge Street, Suite 2700
Toronto, ON M4P 1E4

Re: Enbridge Gas Distribution Inc. (the "Company" or "Enbridge")
EB-2011-0295 - 2012 to 2014 Demand Side Management ("DSM") Plan

Further to the submission of Enbridge dated November 4, 2011, enclosed please find the following corrected evidence:

- Exhibit B, Tab 2, Schedule 9, Appendix A

The application and evidence will be available on the Enbridge website at www.enbridgegas.com/ratecase.

The submission has been submitted through the Board's Regulatory Electronic Submission System ("RESS"). A copy of the on-line confirmation RESS submission reference number has also been included in this package.

If you have any questions, please contact the undersigned.

Yours truly,

Bonnie Jean Adams

Bonnie Jean Adams
Regulatory Coordinator

cc: 2011 DSM Consultative Members (via email)

EXHIBIT LIST AND DESCRIPTIONS

A- ADMINISTRATIVE

Exhibit	Tab	Schedule	Title	Description	Witness(es)
A	1	1	Exhibit List and Descriptions		A. Mandyam J. Ramsay
	2	1	Application		A. Mandyam J. Ramsay
		2	Curriculum Vitae		P. Goldman A. Mandyam J. Ramsay S. Surdu
		3	Glossary of Terms		A. Mandyam J. Ramsay

B- EVIDENCE

Exhibit	Tab	Schedule	Title	Description	Witness(es)
B	1	1	Background and Introduction	Provides the historical context for the development of the 2012 Plan. Describes the consultation process used to develop the plan and presents an outline of the evidence.	P. Goldman A. Mandyam J. Ramsay S. Surdu
		2	2012-2014 Plan Overview	Outlines the Plan's overall strategy and approach. Describes how the Plan addresses the various requirements of the new DSM Framework.	P. Goldman A. Mandyam J. Ramsay S. Surdu

Witnesses: A. Mandyam
J. Ramsay

EXHIBIT LIST AND DESCRIPTIONS

B- EVIDENCE

Exhibit	Tab	Schedule	Title	Description	Witness(es)
B	1	3	Program Types: Budget, Metrics and Targets	Describes the budget, metrics and targets developed for each program type through the Settlement Agreement.	P. Goldman A. Mandyam J. Ramsay S. Surdu
		4	Program Descriptions	Provides a detailed description for each program proposed in the Plan.	P. Goldman A. Mandyam J. Ramsay S. Surdu
		5	Evaluation Plan	Outlines the Evaluation Plan for each program.	A. Mandyam J. Ramsay
		6	Stakeholder Engagement Plan	Presents the proposed Stakeholder Engagement Terms of Reference.	A. Mandyam J. Ramsay
	2	1	System Characteristics/ Rate Allocation Analysis	Provides information on characteristics of the utility's distribution system and information on the rate impacts of the proposed programs.	A. Mandyam J. Ramsay
		2	Avoided Costs	Describes the Company's approach to the development of avoided costs.	A. Mandyam J. Ramsay

Witnesses: A. Mandyam
J. Ramsay

EXHIBIT LIST AND DESCRIPTIONS

B- EVIDENCE

Exhibit	Tab	Schedule	Title	Description	Witness(es)
B	2	3	TRC Analysis	Presents the cost-effectiveness analysis of the proposed programs.	A. Mandyam J. Ramsay
		4	Table of Measure	Presents the assumptions for prescriptive measures eligible to be used in the 2012 programs.	A. Mandyam J. Ramsay
		5	Substantiation Sheets	Provides supporting information on the savings calculation for the prescriptive assumptions listed in the Table of Measure Assumptions.	A. Mandyam J. Ramsay
		6	Table of Measure Lives	Presents the measure life of various technologies used in Custom Resource Acquisition projects.	A. Mandyam J. Ramsay
		7	DSM Potential Study	Presents the latest DSM Potential Study completed for the Company in September of 2009.	A. Mandyam J. Ramsay
		8	Lura Report	Presents the Report by Lura Consulting on Stakeholder Workshops on DSM Strategy held in December of 2010	A. Mandyam J. Ramsay
		9	Settlement Agreement	Presents the full text of the Settlement Agreement reached with respect to the Enbridge 2012 DSM plan.	P. Goldman A. Mandyam J. Ramsay S. Surdu

Witnesses: A. Mandyam
J. Ramsay

ONTARIO ENERGY BOARD

IN THE MATTER OF the *Ontario Energy Board Act, 1998, S.O. 1998*, c. 15, (Schedule B);

AND IN THE MATTER OF an Application by Enbridge Gas Distribution Inc. pursuant to Section 36(1) of the *Ontario Energy Board Act, 1998, S.O. 1998* ("Act") for an Order or Orders approving its Demand Side Management Plan for 2012 - 2014.

APPLICATION

1. Enbridge Gas Distribution Inc. ("Enbridge" or the "Company") is an Ontario corporation with its head office in the City of Toronto. It carries on the business of selling, distributing, transmitting and storing natural gas within Ontario. The Company also undertakes Demand Side Management ("DSM") activities.

2. By letter dated June 30, 2011, the Ontario Energy Board ("OEB" or the "Board") approved and issued the *DSM Guidelines for Natural Gas Utilities* ("DSM Guidelines"). In its letter, the Board stated that it expected gas utilities to develop their DSM plans in accordance with the Board's DSM Guidelines and submit those plans to the Board for approval. As a result of extension requests being granted by the Board, the date for the filing of Enbridge's DSM Plan was extended to November 4, 2011.

3. Enbridge hereby applies to the Board for such final, interim or other Orders and/or Accounting Orders as may be necessary in relation to Enbridge's 2012-2014 DSM Plan, effective January 1, 2012. Enbridge further applies to the Board, pursuant to the provisions of the Act and the Board's *Rules of Practice and Procedure*, for such final and interim Orders and Directions as may be

necessary in relation to the Application, the proper conduct of this proceeding, and the approvals sought in this Application for:

(a) the proposed direction of Enbridge's DSM activities for the 3 year period of 2012-2014

(b) the allocation of DSM budget to the various program types, and the various programs, initiatives and other activities which support and contribute to each program type;

(c) Measure Assumptions and Avoided Costs;

(d) Stakeholder engagement Terms of Reference for the 3 year period of 2012-2014;

(e) the continuation of DSM Deferral and Variance Accounts, as identified in the Guidelines for the 3 year period of 2012-2014;

(f) the DSM Budget for 2012;

(g) program scorecard targets and metrics for 2012; and

(h) DSM incentive amounts and the methodology to calculate same for 2012.

4. The persons affected by this Application are the customers of Enbridge. It is impractical to set out the names and addresses of the customers because they are too numerous.

5. Enbridge requests that a copy of all documents filed with the Board by each party to this proceeding be served on the Applicant and the Applicant's counsel, as follows:

The Applicant
Mr. Norm Ryckman
Director, Regulatory Affairs
Enbridge Gas Distribution Inc.

Address:	500 Consumers Road North York, ON M2J 1P8
Mailing Address:	P.O. Box 650 Scarborough, ON M1K 5E3
Telephone:	(416) 495-5499
Facsimile:	(416) 495-6072
Email:	EGDRegulatoryProceedings@enbridge.com

The Applicant's Counsel

Mr. Dennis M. O'Leary
Aird & Berlis LLP
Barristers and Solicitors

Address:	Brookfield Place, Box 754 Suite 1800, 181 Bay Street Toronto, ON M4J 2T9
Telephone:	(416) 865-4711
Facsimile:	(416) 863-1515
Email:	doleary@airdberlis.com

Please quote the name or docket number of the proceeding in all communications.

Dated: November 4, 2011.

ENBRIDGE GAS DISTRIBUTION INC.

Robert Bourke (for)

Norm Ryckman
Director, Regulatory Affairs

CURRICULUM VITAE OF
PETER GOLDMAN

Experience: <u>Enbridge Gas Distribution Inc.</u>

Manager, Industrial Sales
1998

Gas Utilization Consultant
1993 – 1998

<u>Eclipse Combustion Inc.</u>

Sells Engineer
1983 – 1986

Engineering Manager
1986 - 1993

Education: Mechanical Technology
Ryerson Polytechnic Institute
1979 - 1982

Memberships: The Association of Energy Engineers
Certified Energy Manager (CEM)

Appearances: (Ontario Energy Board)
None to date

CURRICULUM VITAE OF
ANDREW MANDYAM

Experience: Enbridge Gas Distribution Inc.

Manager, Marketing and Energy Efficiency
2010

Customer Information System Replacement Project Business Manager
2007 - 2009

Manager, Customer Care and Customer Information System Program Operations
2006

Manager, Information Technology Solutions and Support
2005

Senior Project Manager, Information Technology Solutions and Support
2003

Oracle Corporation

Practice Manager
1997 – 2003

Compaq Canada

Program Manager
1995 – 1997

Ontario Hydro

Associate Engineer
1990 - 1995

Education: B.A.Sc. Mechanical Engineering
University of Toronto
1990

Memberships: Professional Engineers of Ontario
Project Management Institute

Appearances: (Ontario Energy Board)
- None to date

CURRICULUM VITAE OF
JUDITH RAMSAY

Experience: Enbridge Gas Distribution Inc.

Manager, DSM Research and Evaluation
2005

Senior Analyst, DSM Research and Evaluation
2000-2005

REIC Ltd.

Senior Consultant
1990 – 2000

Project Manager
1982-1990

Education: B.A. (Honours Program)
University of Toronto

Memberships: Association of Energy Services Professionals (Enbridge)
Canadian Evaluation Society

Appearances: (Ontario Energy Board)
- None to date

CURRICULUM VITAE OF
STEFAN SURDU

Experience: Enbridge Gas Distribution Inc.

Sales Manager, Commercial Markets
Since 2006

Program Manager, Energy Technology
2006

Program Manager, Business Markets
2005 - 2006

Energy Solutions Consultant
2003 - 2005

Finn Projects Inc.

Project/Energy Engineer
2002 – 2003

Alfa Laval AB, Europe Central-East

Regional Sales Manager
2000-2001

Applications Engineer
1998-1999

National R&D Institute for Turbo-Engines, Romania

New Product Development Engineer
1997-1998

Education: M.Eng., Mechanical Engineering (Valedictorian), Thermo-Mechanics of Machinery
Polytechnic University of Bucharest, Romania
1998

B.Eng., Mechanical Engineering (Valedictorian)
Polytechnic University of Bucharest, Romania
1997

Memberships: Professional Engineers of Ontario
ASHRAE (American Society of Heating Refrigerating and Air-Conditioning Engineers

Appearances: (Ontario Energy Board)
None to date

GLOSSARY OF TERMS

1) Administrative Costs

Expenses incurred by a utility for program planning, design, management and administration. These costs include general overhead costs required to implement a program, but do not include direct program costs such as purchasing or incentives and indirect costs such as marketing, monitoring, and evaluation costs.

2) Avoided Cost

The unit cost of acquiring the next resource to meet demand, which is used as a measure for evaluating individual demand-side and supply-side options. Avoided cost is the expenditure offset by Enbridge Gas Distribution Inc.'s ("Enbridge") Demand Side Management ("DSM") activities (i.e., the cost of having to buy natural gas on the open market, contract for long-term supply, and the cost of associated transmission and storage.)

3) Benefit/Cost Ratio

The measure benefit/cost ratio indicates the relative attractiveness of the measures. For the purposes of DSM assessments, the benefit/cost ratio is typically associated with the analysis undertaken as part of the Total Resource Cost ("TRC") test. A measure that has a benefit/cost ratio in excess of 1.0 has benefits which outweigh its costs. Similarly, a measure with a benefit/cost ratio that is well in excess of one (e.g., 3.0) means that it is very attractive. A measure with a benefit/cost ratio of less than 1.0 has costs which outweigh its benefits.

4) <u>Building Envelope</u>

The material separation between the interior and the exterior environments of a building. The building envelope serves as the outer shell to protect the indoor environment as well as to facilitate its climate control.

5) <u>Cumulative Natural Gas Savings</u>

Natural gas savings over the life of an installed DSM measure.

6) <u>Customer Class</u>

A group of customers with similar characteristics, such as economic activity or demand level, typically served under the same rate schedule.

7) <u>Deep Energy Savings</u>

Refers to measures that result in long-term savings, such as thermal envelope improvements (e.g., wall and attic insulation).

8) <u>Demand-Side Management (DSM)</u>

Actions taken by a utility or other agency which are expected to influence the amount or timing of a customer's energy consumption.

9) <u>Demand-Side Management Plan</u>

A strategic plan which sets objectives, and directs and controls the implementation, monitoring, and improvement of a utility's preferred DSM Portfolio.

10) Demand-Side Management Portfolio

A group of DSM programs which have been selected and combined in order to achieve the objectives of a utility's DSM Plan.

11) Demand-Side Management Program

An organized collection of related DSM activities or measures which a utility may use to affect the amount and timing of a customer's energy consumption.

12) Discount Rate

The interest rate used in calculating the present value of expected yearly benefits and costs.

13) Energy Audit

An on-site inspection and cataloguing of energy using equipment/buildings, energy consumption and the related end-uses. The purpose is to provide information to the customer and the utility. Audits are useful for load research, for DSM program design, and for identification of specific energy savings measures.

14) Emerging Technologies

New energy-conserving technologies that are not yet market-ready, but may be market-ready over the next 5 to 10 years. This category includes technologies that could be accelerated into the market during that period through targeted financial or technical support.

15) End Use

The final application or final use to which energy is applied, water heating or space heating. End use is often used interchangeably with energy service.

16) Energy Savings

The reduction in use of energy from the pre retrofit baseline to the post retrofit energy use that results from efficient technologies or activities. The term "energy" refers specifically to energy derived from natural gas unless otherwise noted.

17) Financial Incentive

Certain financial features in the utility's DSM programs designed to motivate customer participation.

18) Free Driver

A customer who undertook the program measure as a result of the program but did not access the financial incentive or other support offered by the utility. Savings attributed to any given DSM program are adjusted (upward) by the level of free drivership. Free driver adjustment is also commonly termed "non-participant spillover".

19) Free Rider

A program participant who would have implemented the program measure or practice in the absence of the program. Savings attributed to any given DSM program are adjusted (downward) by the level of free ridership.

20) Load Research

Research to disaggregate and analyze patterns of natural gas consumption by various subsectors and end-uses. Load Research supports the design of demand-side management programs.

21) Lost Opportunity

DSM opportunities that, if not undertaken during a current planning period, will no longer be available or will be substantially more expensive to implement in a subsequent planning period.

22) Market Transformation Programs

Market transformation programs are focused on facilitating fundamental changes that lend to greater market shares of energy-efficient products and services, and on influencing consumer behaviour and attitudes that support reduction in natural gas consumption. They are designed to make a permanent change in the marketplace over a long period of time.

23) Participant

An individual, household, business or other utility customer that received a service or financial assistance offered through a particular utility program, set of utility programs or particular aspect of a utility program in a given program year.

24) Rate Structure

The formulae used by a regulated gas utility to calculate charges for the use of natural gas.

25) Rebates

A type of incentive provided to encourage the adoption of energy efficient practices, typically paid after the measure has been installed. There are typically two types of rebates: a Prescriptive Rebate, which is a prescribed financial incentive/unit for a prescribed list of products and a customized rebate in which the financial incentive is determined using an analysis of the customer equipment and energy savings from a specific project.

26) Resource Acquisition Programs

Are programs that seek to achieve direct, measurable savings customer-by-customer and involve the installation of energy saving equipment or materials.

27) Retrofit

Energy efficiency activities undertaken in existing residential or non residential buildings where existing inefficient equipment is replaced by efficient equipment. In the DSM context, a retrofit is often distinguished from a "replacement" wherein the timing of the retrofit is discretionary while the replacement is required when the equipment fails.

28) Sector

A group of customers having a common type of economic activity.

29) Service Area

The portion of the Province of Ontario that receives service from Enbridge.

30) Simple Payback

The simple payback is generated to show the customer's financial perspective. Simple payback is a measure of the length of time required for the cumulative savings from a project to recover its initial investment cost, without taking into account the time value of money.

31) Sub Sectors

A classification of customers within a sector by common features. Residential subsectors are by type of home (Single Family Dwelling ("SFD"), duplex, apartment, etc.). Commercial subsectors are generally by type of commercial service (office, retail, warehouse, etc.). Industrial subsectors are by product type (pulp and paper, solid wood products, chemicals, etc.).

32) Total Resource Cost ("TRC") Test

A test that compares the total costs of resource focused efficiency investments, including natural gas conservation programs, to the social cost of the resource (i.e., natural gas). The TRC is equal to its full or incremental capital cost (depending on application) plus any change (positive or negative) in the combined annual resource and operating & maintenance costs where the resource costs are the product of the savings and the avoided cost of the resource (natural gas, electricity or water). This calculation includes the following inputs: the avoided natural gas, electricity and water; the life of the measure; the cost of the measure, the selected discount rate and any adjustments that apply including free ridership. It is used in screening, designing and evaluating DSM measures and programs.

33) Utility Cost

The total financial cost incurred by the utility to acquire energy resources.

For DSM, the costs include all utility program costs, including incentive costs.

Witnesses: A. Mandyam
J. Ramsay

BACKGROUND AND INTRODUCTION

1. Beginning in 1995 with a directive from the Ontario Energy Board (the “Board”), (EBO 169), Enbridge Gas Distribution Inc. (the “Company” or “Enbridge”) has provided programs to help customers reduce their demand for natural gas. Since then the Company has helped customers to save over 5.3 billion cubic meters (m^3) of natural gas through its Demand Side Management (“DSM”) programs. In the process, the Company has also contributed to the development of energy efficiency in the province by supporting the widespread adoption of energy efficient equipment and associated practices. As with other disciplines, the discipline of energy efficiency is constantly developing as new products, technologies, and marketing techniques are introduced; what was considered energy efficient in the past may not be today. And so, there is a continuing need for the Company to support customers to adopt practices and products which will result in energy savings.

2. This reality of a continuing need for DSM efforts was recognized by the Board with the release of the *“Demand Side Management Guidelines for Natural Gas Utilities”* (“DSM Guidelines”) on June 30, 2011.

3. This multi-year plan outlining Enbridge’s proposed DSM activities for the period 2012 to 2014 is filed in response to those new Board DSM Guidelines. The previous guidelines were developed in the Natural Gas Demand Side Management Generic Issues proceeding (EB-2006-0021) and were originally intended to apply to the three year period 2007 through to 2009. At the Board’s direction, Enbridge submitted one year plans under the same guidelines for 2010 and 2011. On June

30, 2011, the Board issued the new DSM Guidelines for the next Multi-year plan period (2012 to 2014) and directed the utilities to file their plans with the Board by September 15, 2011. Enbridge undertook an extensive consultation process during the plan development and, following the Company's requests, the Board extended the filing date for the Company's DSM plan ("DSM Plan" or "Plan") to November 4, 2011.

4. The Enbridge 2012 to 2014 DSM Plan is the product of a long development process. In 2009, the Company held a series of internal workshops to define the direction for a new multi-year plan that was to begin in 2010. In April of 2009, the Board directed the utilities to file another one year plan for 2010. In January of 2010, the Board directed Enbridge and Union to file DSM plans for 2011 under the existing guidelines and the Board commissioned Concentric Energy Advisors to provide a report on best practices for natural gas frameworks for DSM.[1] In June of 2010, the Company presented its new direction for DSM in its response to the Concentric Report. In the response, Enbridge outlined the changing circumstances which called for a new approach to the design and delivery of DSM programs for natural gas customers and the Company outlined the principles underlying this new approach. As a next step, in December of 2010, Enbridge convened a series of seven workshops with key stakeholders in the residential, commercial, industrial, and municipal sectors, including attendance by Board Staff and Ministry of Energy staff. The workshops were designed to gather feedback on the Company's current DSM programs and potential improvements or considerations for new approaches. In the first half of 2011, Enbridge staff worked to develop new program concepts

[1] "*Review of Demand Side Management Frameworks for Natural Gas Distributors*", Concentric Energy Advisors, March, 2010.

based on the workshop results while awaiting direction from the Board regarding the Guidelines.

5. Following the release of the Board's DSM Guidelines on June 30, 2011, Enbridge developed this Plan to meet the requirements of the Board's DSM Guidelines regarding budget and program metrics. In August and September of 2011, the Company entered into extensive negotiations with the members of the DSM Consultative to review the Company's draft plan. The results of the collaborative discussions was a Settlement Agreement on the budget allocation, metrics, and targets for the Enbridge 2012 plan and an agreement with Union, Enbridge, and Intervenors on the Terms of Reference for Stakeholder Engagement for the multi-year plan period 2012 to 2014.

6. While the Board's DSM Guidelines request that the utility's plan should cover the three year period 2012, 2013, and 2014, the Board's DSM Guidelines also encourage and suggest differences in the operation of DSM from the current regulatory framework. These differences include and are not limited to: separation of incentive metrics from the screening metric, focus on three program types with heavier weighting towards Low Income, and movement from TRC as the primary unit of measure for DSM to alternatives such as cumulative or lifetime m^3. Enbridge and Intervenors of the DSM Consultative have agreed to establish budget allocations, metrics and targets for 2013 and 2014, after the experience with the proposed 2012 plan is understood. Enbridge proposes to conduct consultations in 2012 with members of the DSM Consultative to finalize the 2013 DSM Plan. It is expected that the 2013 DSM Plan will be filed as an update to this plan in the fall of 2012.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

Influences Shaping the Enbridge 2012 to 2014 Multi-year DSM Plan

7. The Enbridge 2012 to 2014 plan has been shaped by three key influences.

- In 2009 Enbridge began developing a new DSM strategy - a new direction for DSM programs in response to customer needs and changing market conditions.
- In June of 2011, the Board released DSM Guidelines for natural gas utilities which establish budget limits and provide for new metrics and utility performance incentives for DSM activities.
- During August and September of 2011, extensive consultation with Intervenors resulted in acceptance of new program components, an expanded budget for the Low Income program, and agreement on budget allocation, metrics, and targets.

Enbridge New DSM Strategy

8. In the Company's response to the Concentric Report[2], Enbridge outlined the major trends affecting the DSM landscape in Ontario. These include the recognition that first generation DSM activities such as simple rebate transactions have reached maturity in some markets and that there is a need to consider a new suite of programming activities to replace these first generation efforts. At the same time government has expressed increased commitment to energy efficiency in the province and conservation programs in the electricity sector have expanded. As well, uncertain economic conditions have changed the makeup of the customer base in the commercial and industrial sectors and made it more difficult for customers to commit resources to energy efficiency projects.

[2] "*Review of Demand Side Management Frameworks for Natural Gas Distributors",* Concentric Energy Advisors, March, 2010.

9. In this context, Enbridge defined the Company's overarching goal for its DSM activities: "helping customers to achieve deep and lasting energy savings". Enbridge recognized that to do this

> "it will be necessary to move beyond single technology based resource acquisition programs and instead develop initiatives that:
>
> - Avoid lost opportunities through a more integrated, comprehensive, and long term approach to meeting customers energy needs, e.g., whole house retrofits;
> - Recognize that, to the extent that a program will involve energy efficient technology, much potential for savings will be lost unless the behavioural patterns of the customer and their operational practices are addressed;
> - Take a more customer centered approach aimed at building a conservation culture within each organization, e.g., performance based efficiency, continuous commissioning, monitoring and targeting;
> - Focus more on capacity building to develop the necessary soft infrastructure in the Province to further develop and support long term energy efficiency gains, e.g., training technicians in building simulation and/or training contractors in weatherization techniques; and
> - Continue to aggressively support the development of new technologies and market approaches to energy efficiency through research and development."[3]

10. In December of 2010, Enbridge held a series of seven workshops with key stakeholders in the residential, commercial, industrial, and municipal sectors. An additional workshop was also held in February of 2011. Participants included

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[3] 2012 DSM Framework Development, Response to the Report of Concentric Energy Advisors, Enbridge Gas Distribution, June 7, 2010, pg 7.

customers, industry and trade associations, DSM delivery agents, municipal representatives, Board Staff, and Ministry of Energy Staff. Facilitated by Lura Consulting, the workshops reinforced the approach which Enbridge had defined and provided helpful suggestions for new programs and for enhancing existing programs. The Lura Report can be found at Exhibit B, Tab 2, Schedule 8. Several common themes emerged across all the sectors as noted below.

- Energy Efficiency Drivers: Customers require relatively short payback periods; more incentives and increased subsidies are needed. Monitoring, data analysis, and benchmarking are essential tools to understanding the need for energy efficiency.
- Awareness: Enbridge is a well-respected organization and can play an important role in providing customers with credible information about energy efficiency. Information may be provided through case studies, a website / forum, trade and professional associations, and other means.
- Long-Term Approach: The Enbridge long-term approach and strategy has the right focus for achieving long-term, deep savings[4]. Spurring cultural change and market transformation[5] takes a significant amount of time. There is a need for consistent and reliable funding for DSM programs.

[4] As described in the Board's DSM Guidelines, (pg 4), "Deep savings refer to measures that result in long-term savings, such as thermal envelope improvements (e.g., wall and attic insulation)."
[5] As described in the Board's DSM Guidelines, (pg 10), "Market transformation programs are focused on facilitating fundamental changes that lend to greater market shares of energy-efficient products and services, and on influencing consumer behavior and attitudes that support reduction in natural gas consumption. They are designed to make a permanent change in the marketplace over a long period of time."

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

- Emphasis on Results: Enbridge can play a valuable role in testing new equipment and technologies and should lead research and pilot projects to provide customers with reliable and accurate data. Enbridge should work with partners to support building commissioning and to improve energy rating systems.
- Integration: Customers need simplified access to energy efficiency information and DSM programs. Utilities and municipalities should collaborate to provide a "one stop shop" approach.

Board DSM Guidelines

11. The Board's DSM Guidelines released on June 30, 2011, were also the result of a long period of study and consultation, led by the Board and beginning in 2008. The Company's view on the DSM framework issues was presented in its response to the Concentric Report in June of 2010 and in its February, 2011 response to the Draft DSM Guidelines issued by the Board in January of 2011. Several aspects of the new Guidelines had a major influence on the direction and content of the Enbridge 2012 DSM Plan.

12. The Board's DSM Guidelines, among other things, established a budget cap for DSM programs for 2012. The budget cap limits the extent of program offerings for both traditional resource acquisition programs and new initiatives. At the same time, the Board's DSM Guidelines allowed for flexibility through two additional budget provisions. The first is an option to increase funding for Low Income programs by up to 10% of the total DSM budget. The second is a provision removing the utilities' obligation to provide ratepayer funded DSM programs for large industrial customers, but allowing for programs for these customers to be

considered on their merits. Enbridge has developed a robust plan under the terms of the budget cap and provisions. The Company's DSM Plan addresses all sectors of the economy and introduces new market transformation programming efforts that represent the future of DSM.

13. Enbridge notes that this fulsome set of activities will be delivered into a marketplace where electricity focused Conservation and Demand Management ("CDM") programs delivered by electric LDCs are also available to customers. This is an important consideration for the next three years as the Company strives to maximize participation in the various programs.

14. Under the previous Board DSM Guidelines, the performance incentive for the natural gas utilities was based on a calculation of societal benefits including savings of water, and electricity as well as natural gas. The use of cumulative cubic meters of natural gas saved ("m3") as a performance metric encourages the Company to focus more on long-term natural gas savings, makes savings metrics more meaningful to the average person, and facilitates collaboration with LDCs in the electricity sector by avoiding any potential competition for electricity savings.

15. Retention of the Total Resource Cost Test ("TRC test")[6] as a screening mechanism ensures that the programs will be cost effective and encourages the promotion of all cost effective measures that result in natural gas savings. This

[6] The TRC test is a measure of the cost-effectiveness of an energy efficiency measure. The TRC test calculates the net present value of the natural gas, water or electricity saved over the lifetime of the measure, taking into account the cost of the efficiency measure and the utility's costs to promote it. The TRC test is widely used in utility DSM programs throughout North America.

provides more flexibility for the utilities to address customer needs and promote a holistic approach to energy savings in homes and buildings.

16. The provision of flexibility in program metrics for all program types including resource acquisition programs acknowledges that programs may have multiple objectives which warrant performance incentives.

Consultation with Intervenors

17. At a Consultative meeting held on July 20, 2011, the Company invited Intervenors to form a small working group with the goal of achieving agreement on the 2012 DSM Plan budget allocation, scorecard, metrics and targets. Following the Consultative suggestion, the Company convened a series of open meetings so that any member of the Consultative might attend sessions of interest to them. The meetings were based on Program Type as defined in the Board's DSM Guidelines (Low Income, Market Transformation, and Resource Acquisition) and, in addition, two plenary meetings were held.

Program Type/ Meeting	Consultative Meeting Date
Plenary	August 9, 2011
Low Income	August 16 and 18, 2011
Market Transformation	August 23 and 25, 2011 and a conference call on August 26, 2011
Resource Acquisition	August 30, 31, September 6, 14, 15, 2011
Plenary	September 21, 2011

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

18. Participants in the working groups were:
    a. Low Income: Chris Neme (GEC), Marion Fraser (LIEN), Jack Gibbons (Pollution Probe), and Roger Higgin (VECC)
    b. Market Transformation: Julie Boudreau (BOMA), Vince DeRose (CME), Chris Neme (GEC), Marion Fraser (LIEN), and Jack Gibbons (Pollution Probe)
    c. Resource Acquisition: Julie Boudreau (BOMA), Julie Girvan (CCC), Vince DeRose (CME), Chris Neme (GEC), Ian Mondrow (IGUA), Marion Fraser (LIEN), Jack Gibbons (Pollution Probe), Jay Shepherd (SEC), and Roger Higgin (VECC)

19. The resulting DSM Plan for 2012 reflects the agreement reached on customer offerings, program budgets, metrics, and targets. It also includes several features which were developed through the consultation process. The DSM Plan includes the conditional provision to expand the Low Income budget by an additional 10% of the total budget and to apply the additional $2.81M to the Low Income Program as documented in the Settlement Agreement. A separate budget cap is included for rate classes with large industrial customers. As well, a new set of market transformation programs was approved including one program (Home Labelling) which was developed during the consultation.

20. This submission presents the Enbridge 2012 DSM plan, the Settlement Agreement, and associated information as required by the Guidelines.
    - Exhibit B, Tab 1, Schedule 2 provides an Overview of the plan
    - Exhibit B, Tab 1, Schedule 3 presents the Program Budgets, Metrics, and Targets as referenced in the Settlement Agreement

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

- Exhibit B, Tab 1, Schedule 4 - Program Descriptions – includes detailed information on the individual programs
- Exhibit B, Tab 1,Schedule 5 outlines the program Evaluation Plans
- Exhibit B, Tab 1, Schedule 6 presents the Terms of Reference for Stakeholder Engagement
- Exhibit B, Tab 2, Schedules 1 to 9 present additional supporting materials.

Witnesses: P. Goldman
A. Mandyam
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S. Surdu

PLAN OVERVIEW

2012 DSM Plan Key Features

1. The key features of the Enbridge Gas Distribution Inc. (the "Company" or "Enbridge") 2012 to 2014 Demand Side Management Plan ("DSM Plan") address the themes identified in the Enbridge strategy and in the Ontario Energy Board's ("Board") *"Demand Side Management Guidelines for Natural Gas Utilities"* ("DSM Guidelines") issued on June 30, 2011. The key features reflect the extensive consultation and agreement between Enbridge and Intervenors. Overall, the plan represents the continuation of most traditional program initiatives while, at the same time, adding new programs and program components that focus on deep savings and capability building to help customers better manage their energy use.

Budget

2. Table 1 provided below outlines the calculation of the overall budget and the Low Income Budget for 2012. Table 2 on the following page provides the 2012 budget for program types.

Table 1

Calculation of Overall Budget	
Base Budget	$28,100,000
10% increase for Low Income programs	$2,810,000
Total Budget	$30,910,000

Calculation of Low Income Budget	
Base Budget @15% of Base Budget of $28.1M	$4,125,000
10% increase	$2,810,000
Total Low Income Budget	$7,025,000

Witnesses: P. Goldman
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Table 2

Program Type	Program Budget	Overheads	Total Budget	% of Total	Maximum Incentive Available
Low Income	$6,120,650	$904,350	$7,025,000	22.73%	$2,375,000
Market Transformation	$3,920,000	$913,600	$4,833,600	15.64%	$1,634,135
Resource Acquisition	$15,125,000	$3,926,400	$19,051,400	61.64%	$6,440,865
Total	$25,165,650	$5,744,350	$30,910,000	100%	$10,450,000

3. Compared to previous years the budget reflects a shift in emphasis with increased focus on Low Income and Market Transformation programs. Even with these changes, the Resource Acquisition program type is still the dominant feature of the portfolio.

4. While the budget does not include a line item for Research and Development (“R&D”) and Pilot Programs, the Company anticipates that with the future plan submissions it may also allocate some funds to this program type. The Company acknowledges that budget expenditures for R&D and Pilot Programs will have the effect of reducing the available performance incentive proportionately. For example, if the Company were to expend $310,000 on a pilot program, this amount represents approximately 1% of the total DSM budget of $30.91M. The maximum incentive of $10.45M would then be reduced by 1%, resulting in a maximum incentive of $10.35.

Witnesses: P. Goldman
A. Mandyam
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Metrics and Targets

5. Table 3 provides the proposed metrics and targets for 2012.

Table 3

	Metric at 100% of Target: Cumulative Savings Million m^3	Metric at 100% of Target: Other
Low Income		
Part 9 Buildings	17	
Part 3 Buildings	45	
Total Low Income	62	
Resource Acquisition		
Cumulative savings	820.4	
Residential deep savings		160 homes
Commercial, Industrial deep savings		45% of projects
Market Transformation		
Savings by Design Commercial		8 builders enrolled
Savings by Design Residential		2 of top 20 builders 9 of top 80 builders
DrainWater Heat Recovery		4,000 units
Home Labelling		Realtors with 5,000 listings

6. Note that the budget, metrics, and targets were developed as an integrated package and are also linked to the incentive structure. A change to any one element will effect a change in the others.

Witnesses: P. Goldman
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Low Income Program Type

7. The Low Income Program will continue in 2012 with the program offers of TAPS direct install of basic measures including low flow showerheads, faucet aerators, and programmable thermostats and with support for weatherization and deep retrofit activities such as insulation or furnace replacement in low-rise residential dwellings. These program initiatives will be enhanced in the following ways.

- The TAPS direct install measures will be integrated with the weatherization initiative on a neighbourhood basis. The TAPS offer will be used as a means of recruiting participants to undertake the weatherization or home retrofit measures. This will make maximum use of resources and increase program exposure at the neighbourhood level. Using customer data and information from other sources, Enbridge will identify neighbourhoods with a significant number of low income households and with age-appropriate housing stock.
- Support for building retrofit will be extended to multi-residential buildings and single dwellings owned by social housing providers. Multi-residential buildings will also be eligible for direct install of in-suite basic measures such as low flow showerheads or reflector panels, and for rebates for “custom” measures such as boiler retrofits or thermal envelope improvements.
- The increased budget allows for enhanced support for both the basic measures and the building retrofit initiatives.

Market Transformation Program Type

8. Three new programs have been added to the Market Transformation portfolio. The two Savings by Design programs have been developed to address lost opportunities in the Residential and Commercial new construction sectors. Both

programs focus on working with builders and developers to develop the capability within their companies to design and build advanced energy efficient homes and buildings. The existing Drain Water Heat Recovery program will be used as a door opener to recruit home builders into the Residential Savings by Design program. The third new program, Home Labelling, targets the home re-sale market by encouraging home sellers and purchasers to have the home inspected, rated, and subsequently labelled using an approved energy efficiency rating tool. The adoption and use of the Home Label will help customers to make wise energy choices when purchasing or renovating a home.

Resource Acquisition Program Type

a) Residential

9. In 2012, Enbridge will continue the TAPS direct install water savings program but on a smaller scale as the program gradually winds down. In the new home market, a similar kit based approach will offer a suite of measures aimed at saving water, natural gas, and electricity. The Company will introduce a new program, Community Energy Retrofit, which will encourage customers to undertake extensive energy retrofit measures with associated deep savings. This program initiative will address the significant barriers to residential building retrofit by focusing intensive promotion and support on one community or neighbourhood of older homes which are high users of natural gas and by offering a “one-stop” customer service including financing options. The Community Energy Retrofit initiative is being developed in collaboration with other agencies with the intention to replicate the approach in other communities in future years.

b) Commercial

10. The Commercial program will continue with the traditional program elements offering incentives for installation of prescriptive measures and custom energy efficiency projects. At the same time, the Company will add new program elements designed to help customers build the capacity to make data driven decisions in managing their energy use and retrofit projects. The Energy Compass initiative is designed to help facility managers benchmark the energy performance of the buildings within their supervision and make informed decisions regarding future energy retrofit activities. Run It Right enlists customers to an ongoing process of energy efficiency improvement and provides customers with the tools and training to operate their buildings for maximum energy efficiency. Both these initiatives represent a more customer focused approach to DSM activities with specific activities tailored to the needs of the individual customer. In addition to these activities for larger commercial customers, Enbridge will continue to offer prescriptive measures available for small commercial customers and explore other means of reaching this market segment. In the new construction market, the Company will continue to offer the existing Design Assistance and New Construction Programs with the intent of using 2012 as a transition year while the new Savings by Design market transformation program is rolled out.

c) Industrial

11. As with the Commercial sector, Enbridge will continue to offer traditional custom project incentives for larger industrial customers. In 2012 the level of this activity will be capped as per the Settlement Agreement. In 2012, the Company will also introduce prescriptive rebate offers for medium and smaller sized industrial customers. For all customer groups, the Company will emphasize Continuous Improvement, encouraging customers to adopt energy management as an

ongoing activity and helping customers to develop their energy management capabilities by providing customer support at every stage of decision making.

Regulatory Framework

12. The following sub sections provide an overview of the Company's DSM Plan features in relation to the Board's DSM Guidelines. For ease of reference it follows the Table of Contents headings as presented in the Board's DSM Guidelines.

a) Term of the Plan

13. The Company's DSM Plan presents the proposed direction for Enbridge DSM activities for the three year period 2012 to 2014. To implement the new direction, the Plan includes several new programs and program elements. The DSM Plan departs from the Board's DSM Guidelines in that program budget allocations, metrics, and targets are defined for 2012 only. Experience gained through implementation of new initiatives in 2012 will materially inform detailed plans for 2013 and 2014. Enbridge expects that DSM Plan direction, focus areas and approach to new customer offerings in the Resource Acquisition and Market Transformation program types will be retained as core plan components through 2014. Enbridge therefore proposes, as described in the Settlement Agreement, that the Company will file a DSM Plan, presenting budget allocations, metrics and targets for 2013, or 2013-2014 sometime in 2012.

b) Portfolio Design

14. The Company's 2012 DSM Plan follows the Board's DSM Guidelines objectives for portfolio design:

- "Maximization of cost effective natural gas savings
- Prevention of Lost Opportunities, and
- Pursuit of deep energy savings."[1]

15. The Company's DSM Plan includes aggressive targets to maximize cost-effective natural gas savings. In addition, the DSM Plan includes two new programs to prevent lost opportunities (Savings by Design Residential and Savings by Design Commercial). The portfolio emphasizes the pursuit of deep energy savings through aggressive Resource Acquisition targets for cumulative gas savings and through specific deep savings metrics for the Community Energy Retrofit Initiative and also through the commercial and industrial custom project initiatives.

16. Also, Enbridge has organized the DSM programs within the three generic Program Types as suggested by the Board's DSM Guidelines: Resource Acquisition, Market Transformation, and Low Income.

c) Program Types

17. The Company's DSM Plan follows the Board's DSM Guidelines in the types of activities included with each program type. As well, for the Low Income Program, the plan follows the detailed Guidelines regarding Guiding Principles, Definition of Social and Assisted Housing, and Low Income Eligibility Criteria.

[1] "*Demand Side Management Guidelines for Natural Gas Utilities*", EB-2008-0346, Ontario Energy Board, June 30, 2011, p. 4.

18. While Enbridge did not identify any specific R&D or pilot programs at this time, the Company anticipates that it may also engage in these activities to a limited extent during the term of the plan. The Company recognizes that, to the extent that it expends budget in these areas, the available performance incentive in the particular year the activities take place will be reduced proportionately. For example, if the Company were to expend $310,000 on a pilot program, this amount represents approximately 1% of the total DSM budget of $30.91M. The maximum incentive of $10.45M would then be reduced by 1%, resulting in a maximum incentive of $10.35M.

d) Screening and Prioritization

19. As outlined in the Board's DSM Guidelines, Enbridge has screened the 2012 Resource Acquisition and Low Income programs using the TRC test. The Company affirms that the programs have positive TRC results. Further, the Company notes that, with few exceptions, the measure assumptions are those that were Board approved in the Company's 2011 Update submission (EB-2011-0254). The few exceptions are for those measures which were a later Board approved update from Union Gas Limited ("Union") and represent best available information. These references are noted in the Enbridge Assumption Table. The TRC analysis, Table of Measure Assumptions and supporting Substantiation Documents which present the savings calculations for individual measures are included in Exhibit B, Tab 2, Schedules 3 to 6.

e) Development, Updating and Use of Assumptions

20. The Board's DSM Guidelines encourage the utilities to cooperate in preparing their individual applications for updates and/or additions to the set of approved input assumptions. In anticipation of this requirement and for ease of reference, Enbridge and Union collaborated to prepare a common Table of Measure

Assumptions and set of Substantiation Documents 9 for inclusion with their 2012 to 2014 Plan submissions (Exhibit B, Tab 2, Schedules 4 and 5). The Table of Measure Assumptions indicates where a measure applies to one or to both utilities. For reference, all the Enbridge measures on the Table of Measure Assumptions have been previously approved by the Board. Enbridge has also filed a Table of Measure Lives for Custom Project Technologies (Exhibit B, Tab 2, Schedule 6). This Table includes one new assumption as recommended in the Enbridge 2010 Audit Report.

21. Enbridge notes that avoided costs for 2011 were used in the TRC analysis. The avoided costs for 2012 are currently being updated using the methodology approved by the Board in EB-2006-0021 Part III. The Company will file the updated 2012 avoided costs with the Board when they are available. Following the Board's DSM Guidelines, Enbridge will update avoided costs for 2013 and 2014 based on changes in commodity costs only with all other avoided costs to remain fixed for the duration of the plan.

f) Adjustment Factors

22. The Company's DSM Plan follows the Board's DSM Guidelines with respect to Adjustment Factors. Resource Acquisition Programs were screened using Board approved Adjustment Factors for free ridership as included in the Company's 2011 DSM Measures application (EB-2011-0254). For reference, the free ridership adjustment factors are included on the Table of Measure Assumptions found at Exhibit B, Tab 2, Schedule 4. Also, adjustment factors for persistence are addressed through evaluation of individual DSM activities as appropriate.

g) Budget

23. Development of the budget follows the Board's DSM Guidelines which called for a base budget of $28.1M for the Enbridge portfolio. Following consultation with Intervenors, this was increased by 10% to $30.9M with the additional funds to be applied to the Low Income program only. This increased the Low Income budget from $4.215M to $7.025M. As shown in Table 2 on page 2 of this exhibit, even with the additional funding for the Low Income program, the Resource Acquisition program type follows the Guidelines in maintaining the largest share of the DSM budget.

24. Regarding programs for Industrial customers, following consultation with Intervenors, the Company proposes to limit program funding directed to large industrial customers as described in the Settlement Agreement.

25. As per the Board's DSM Guidelines, the budget for Market Transformation programs was also developed in consultation with Intervenors.

26. In keeping with the Board's DSM Guidelines, the evaluation, monitoring, and verification activities and associated budget proposed for 2012 reflect the ongoing discussions with the current Evaluation Audit Committee. These are described in Exhibit B, Tab 1, Schedule 5. The evaluation requirements will be modified throughout the term of the Company's DSM Plan in consultation with Intervenors as provided in the Terms of Reference for Stakeholder Engagement described in Exhibit B, Tab 1, Schedule 6 and presented in full in Appendix A of the Settlement Agreement (Exhibit B, Tab 2, Schedule 9).

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

27. As per the Board's DSM Guidelines, DSM spending will be tracked at the rate class level and the Demand Side Management Variance Account ("DSMVA") will be used to "true-up" any variances between the spending estimate built into rates and the actual spending."[2] As suggested by the Board's DSM Guidelines, the Company's DSM Plan document should include "the total amount of DSM spending to be recovered in rates and the allocation of those costs to the customer class(es) that will benefit from the DSM program applied for;".[3] Enbridge understands this to mean that DSM Program and overhead costs should be allocated to rate classes on the basis of spending. Exhibit B, Tab 2, Schedule 1 provides the information on total DSM spending and allocation of costs to customer classes.

h) Metrics and Targets

28. As suggested by the Board's DSM Guidelines, Enbridge has developed the program metrics and targets in consultation with Intervenors. The proposed metrics and targets for 2012 are provided in Table 3 on page 3 of this exhibit, and in the Settlement Agreement found at Exhibit B, Tab 2, Schedule 9. As shown in Table 3, the metrics for Resource Acquisition and Market Transformation programs follow a scorecard approach as referenced in the Board's DSM Guidelines. One metric, cumulative m^3 is proposed for the Low Income Program.

29. Exhibit B, Tab 1, Schedule 3, Program Types: Budgets, Metrics and Targets and Exhibit B, Tab 1, Schedule 4, Program Descriptions, provide evidence on the challenges in meeting the scorecard targets.

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[2] "*Demand Side Management Guidelines for Natural Gas Utilities"*, EB-2008-0346, Ontario Energy Board, June 30, 2011, p. 26.
[3] Ibid, p. 46.

Witnesses: P. Goldman
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30. The three elements of the "financial package", budgets, targets, and incentive are linked. Should the Board determine that the incentive for 2012 is capped at $9.5 million, Enbridge may, at its discretion, decline to increase the budget for Low Income Programs by all or any portion of the $2.81 million. Targets in the Company's DSM Plan are linked to the budget proposed for each program type. In the event that the Board approves a different budget than the amount proposed in the Company's DSM Plan and the Settlement Agreement, then the relevant target(s) shall be adjusted accordingly.

31. As noted in the section Term of the Plan (Exhibit B, Tab 1, Schedule 2, pg 7, sub-section a) , budget allocations, metrics, and targets for 2013 or 2013 to 2014 will be submitted to the Board for approval sometime in 2012.

<u>i) Incentive</u>

32. Enbridge proposes that the maximum incentive available for 2012 is $10.45M. As per the Board's DSM Guidelines, the maximum incentive available at a budget of $28.1 million is $9.5 million. With the additional 10% funding to the Low Income program, the available incentive is increased proportionately to $10.45 million. This is in keeping with the approach as outlined in the Board's DSM Guidelines as provided on the following page:

> The natural gas utilities' total DSM budgets may be increased by up to 10%, provided the funds are solely used to support low-income programs. This means the total DSM budget for Enbridge may be increased by $2.81 million and by $2.74 million for Union. This funding increase will be considered incremental to the natural gas utilities' total DSM budget and is not cumulative.[4]

And

> To the extent that the approved DSM budgets deviate in magnitude from the Board proposed budgets, the Annual Cap should be scaled accordingly. This will help ensure that the eligible incentive amount is consistent with the expected level of efforts require[d} to achieve or exceed the approved targets.[5]

33. Enbridge has followed the Board's DSM Guidelines in allocating the Annual Incentive Cap among the three generic program types based on the proposed budget share as shown in Table 2, above. It is Enbridge's understanding that the Board's DSM Guidelines approach to a scalable incentive is a recognition of level of effort increase with an associated increase in DSM budget. The additional 10% budget increase to the Low Income Program Type represents a 65% increase to the Low Income budget from the Board's DSM Guidelines minimum budget. An increase of 10% to the incentive cap does not ensure that the utility will achieve the additional increase to the incentive. However, the approval of the incentive cap increase recognizes the increase in level of effort and provides motivation for the utility to pursue the DSM line of business.

34. As per the Board's DSM Guidelines, any incentive amounts will "be allocated to rate classes in proportion of the amount actually spent on each rate class."[6]

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[4] "*Demand Side Management Guidelines for Natural Gas Utilities*" EB-2008-0346, Ontario Energy Board, June 30, 2011. p.26.
[5] ibid. p.31
[6] Ibid. p. 31

Witnesses: P. Goldman
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j) Lost Revenue Adjustment Mechanism ("LRAM")

35. Enbridge's current practice of calculating first year impact of DSM programs on a monthly basis is consistent with the Board DSM Guidelines and the Company will continue with this practice for the period of the Multi-year plan.

k) Accounting Treatment and Annual Application for Disposition of Balances

36. As is the current practice, Enbridge will record balances in the following variance accounts: LRAM, DSMVA, and Demand Side Management Incentive Deferral Account ("DSMIDA"). Following the annual audit of DSM results, the Company will make an annual application to the Board to clear any balances in the LRAM, DSMVA, and DSMIDA accounts. This is consistent with the Board's DSM Guidelines.

l) Evaluation and Audit

37. Following current practice and the Board's DSM Guidelines, Enbridge will produce an Annual Report of program results for independent audit. The Annual Report will include the results of an annual evaluation of a sample of custom projects in the commercial and industrial sectors as well as results of any other verification and evaluation studies. Further provisions for evaluation research including program evaluation costs are found in the Evaluation Plan (Exhibit B, Tab 1, Schedule 5) and the Terms of Reference for Stakeholder Engagement (Exhibit B, Tab 2, Schedule 9, Schedule A).

m) Stakeholder Consultation

38. Following the Board's DSM Guidelines, Enbridge and Union consulted extensively with Intervenors to develop Terms of Reference for Stakeholder Engagement during the Multi-year plan period. The resulting agreement on the Terms of

Reference is introduced in Exhibit B, Tab 1, Schedule 6. The full agreement on Terms of Reference is included as Schedule A with Exhibit B, Tab 2, Schedule 9.

n) Coordination and Integration of Natural Gas and Electricity Conservation Programs

39. In keeping with the Board's DSM Guidelines, Enbridge remains receptive to opportunities to collaborate with electric Local Distribution Companies ("LDC") in the delivery of DSM / Conservation Demand Side Management Programs and will pursue opportunities as they present themselves.

PROGRAM TYPES: BUDGET, METRICS AND TARGETS

1. As described in Exhibit B, Tab 1, Schedule 2, the Enbridge Gas Distributions Inc.'s (the "Company" or "Enbridge") 2012 Demand Side Management Plan ("DSM Plan") was developed in consultation with the Demand side Management ("DSM") Consultative and an associated settlement process. The Company's DSM Plan's Budget Allocation, Metrics, and Targets are all included as part of the Settlement Agreement included in Exhibit B, Tab 2, Schedule 9.

2. The Settlement Agreement resulted in a DSM portfolio for 2012 with a total budget of \$30.91M which included an additional \$2.81M above the base budget to be applied to the Low Income Program Type. The resulting budget allocation between program types is shown in the table below together with a summary of the budgeted natural gas savings.

Program Type	Net effective m^3	Cumulative m^3	Program Budget	Overheads	Total
Resource Acquisition	49,662,558	820,453,481	\$15,125,000	\$3,926,400	\$19,051,400
Low Income	3,900,047	62,463,070	\$6,120,650	\$904,350	\$7,025,000
Market Transformation			\$3,920,000	\$913,600	\$4,833,600
Total	53,562,605	882,916,551	\$25,165,650	\$5,744,350	\$30,910,000

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

3. Other key features of the Enbridge DSM portfolio include:
   - A greater emphasis on market transformation activities;
   - In Resource Acquisition, maintaining traditional DSM program offers while introducing new initiatives that emphasize helping customers to build the capability to identify and implement further energy savings;
   - Increased emphasis on deep savings; and
   - Introduction of five new program offers including two new market transformation initiatives.

4. The following sections highlight the key elements of the Company's 2012 DSM Plan for each Program Type including the Program Terms included in the Settlement Agreement and Commentary on the Program Terms. For clarity, the Commentary on Program Terms has been prepared by Enbridge without comment from intervenors. Further detail on the program initiatives within each Program Type can be found in Exhibit B, Tab 1, Schedule 4, Program Descriptions.

Resource Acquisition Program Type

5. In 2012, the Resource Acquisition program type is still a major focus of the Enbridge DSM portfolio even with the increase in Low Income budget and increased focus on Market Transformation. Within the Resource Acquisition program type Enbridge is also shifting focus in response to market conditions and expressed customer needs.

6. While retaining the traditional single transaction or rebate based program offers, Enbridge has added new program initiatives to respond to customer needs and to address key barriers and opportunities in the marketplace.

7. In the Residential sector new initiatives include a new community-based approach to address barriers to residential retrofit and to unlock deep savings.

8. As well, the industrial sector will see a shift in focus from large customers to medium and smaller customers.

9. For larger customers in the Commercial and Industrial sectors, the focus is on initiatives that respond to customer needs for direct support enabling data collection, ongoing monitoring of consumption, analytical capability, assistance in data driven decision making, benchmarking and operator/staff training. The overall objective of this approach is to help business customers entrench energy efficiency as a core value and an ongoing management focus and to provide customers with the tools to get them started.

<u>a) Program Terms</u>

10. The Program Terms noted below list those aspects of the program that were of particular interest during the consultation and that are included in the Settlement Agreement:

- Resource Acquisition program budget = $19,051,400 (including $15,125,000 in program costs)
- Enbridge intends to utilize $1.9 million of the Resource Acquisition budget in the Energy Compass/Run it Right activity. Except as noted in (b) below, none of the cubic meters of gas saved in 2012 from this activity may be included for the purposes of calculating Enbridge's 2012 Resource Acquisition Scorecard performance. In the event that Enbridge shifts funds from the Energy Compass/Run it Right activity to any other program or activity, the "lifetime cubic meter" targets at all three levels (i.e., lower,

middle, and upper) shall increase by 50 cubic meters for each dollar shifted. For example, if Enbridge shifts $500,000 to other programs or activities, the targets are increased by 25 million cubic meters, i.e., to 640.3, 845.4, and 1050.5 million m^3.

- Capital improvement projects, or "Custom Projects", that are identified by the Energy Compass/Run it Right activity reviews are not considered to be part of the results from Energy Compass/Run it Right for the purpose of (a) above. The lifetime cubic meters achieved from those Custom Projects completed in 2012 will be included for the purpose of calculating scorecard performance in the same manner as if they had not been identified through Energy Compass/Run it Right,

- The Energy Compass/Run it Right program is intended to contribute natural gas savings towards the 2013 and subsequent year's savings targets and scorecard performance. The spending in 2012 on the Energy Compass/Run it Right program therefore shall be considered a program cost under the Resource Acquisition budget.

- The Residential Deep Savings Target shall be based on the number of homes retrofitted. On average, the customers counted towards the deep savings metric must achieve at least a 25% reduction in annual gas usage for space and water heating, in aggregate (also based on HOT2000 software used in EnerGuide mode), for the utility to be eligible to earn any shareholder incentive. In addition, each participant must a) achieve a minimum gas savings of 11,000 lifetime m^3 (based on HOT2000 software used in EnerGuide mode), and b) implement a minimum of two major measures. The following are examples of major measures:

i. Heating system replacement
ii. Water heating system replacement
iii. Attic insulation
iv. Wall insulation
v. Foundation insulation
vi. Air sealing (minimum reduction of at least 10% as measured by a blower door)
vii. Window replacements
viii. DrainWater heat recovery

- The Commercial/Industrial Deep Savings Target will be based on the percentage of Commercial/Industrial Custom Project participants that achieve 25% or greater annual gas savings. This will be calculated by comparing, for each participant, the forecast weather normalized annual gas savings from the custom project against the actual weather normalized consumption of the participant for the immediately preceding year. If a prescriptive boiler rebate is provided in addition to other custom measures, its savings will still be included for the purpose of calculating the total project savings.

- Enbridge will commission an Industrial Free Ridership study, designed to allow estimation of free ridership separately for small (less than 0.3 million annual m^3 consumption), medium (between 0.3 million and 1.5 million annual m^3 consumption) and large customers (greater than 1.5 million annual m^3 consumption), to update input assumptions for this sector. The Parties acknowledge that the lifetime cubic meter savings targets (Lower, Middle, and Upper) for the Resource Acquisition program portfolio are predicated on the placeholder assumption that the free ridership rate for all industrial customers of all sizes is 50%. It is agreed that the free ridership for small and/or medium sized industrial customers shall remain at 50% for 2012.

- Upon an Intervenor who is party to this Agreement executing an appropriate Declaration and Undertaking, Enbridge will, for the purpose of allowing that Intervenor to review the assumptions underlying this Agreement, provide to that Intervenor at least one week prior to filing its 2012 DSM Plan an electronic copy of the 2008 through 2012 TRC spreadsheets at their current level, subject to appropriate redaction protecting the identities of individual customers/businesses.

- Enbridge may access the DSMVA to achieve Resource Acquisition program performance in excess of 100%.

- Enbridge will have the right, in the manner described in the Guidelines, to re-allocate budget between customer classes and groups to optimize the effectiveness of its DSM Plan. However, the Parties agree, for 2012 only, that the total budget spent on programs and activities (not including overheads, Market Transformation and Low Income Allocations) for all customers in rate classes 110, 115, and 170 shall not exceed $2.709 million, of which the total budget spent on programs and activities (not including overheads and Low Income Allocations) for industrial customers in those rate classes shall not exceed $1.797 million. These amounts are inclusive of any amounts drawn from the DSMVA. The purpose of this dual limit is to ensure that the total unit cost to be borne by customers in these rate classes is capped, but that non-industrial customers in these rate classes still have access to sufficient availability of funds in excess of budgeted amounts to participate in incremental (relative to budget) delivery of cost-effective programs. The Parties agree that this limitation is intended to be a transitional provision for one year only, and the Parties confirm their mutual intent to discuss more long-lasting provisions that could address the concerns of all customers in these three rate classes.

b) Commentary

11. Through the Energy Compass and Run It Right initiatives the Company assists large commercial customers and their energy managers to help them better manage the buildings in their portfolios, identify cost effective capital improvements, and implement operational improvements to achieve energy savings. Savings results from operational improvements implemented in any given year are recorded in the next year, following monitoring and verification. Hence the condition that Enbridge will not claim m^3 in 2012 from Run It Right initiatives implemented in 2012 but will claim those results in 2013 and beyond. However, both Energy Compass and Run It Right may also result in the identification and implementation of capital improvements that provide energy savings. These will be treated the same as other custom projects and counted towards the 2012 m^3 target. As with other program offers, the costs of promoting Energy Compass and Run It Right, providing operator training and other services will be recorded as program costs. There is a provision that, if Enbridge diverts allocated budget dollars away from Energy Compass and Run It Right to other initiatives, the Company's m^3 target will be increased accordingly.

12. Free ridership rates are input assumptions used to calculate the net m^3 savings which the utility may claim against the target. The free ridership rates for the Commercial and Industrial sectors were set following a free ridership study in

2008. The study was based solely on custom projects involving larger customers; the resulting free ridership rate for the Industrial sector is 50%. Recognizing that small industrial customers constitute a different market, the need for a study to establish a free ridership rate for this sector was acknowledged. Given the nature of the small industrial market it is expected that the free ridership in this market will be considerably lower. Recognizing that the targets were set on the basis of 50% free ridership, the Company and Intervenors party to the Settlement Agreement propose to retain the 50% rate for 2012, even if new information becomes available before the time of the 2012 audit.

c) Scorecard

13. The table below provides the 2012 DSM Resource Acquisition Scorecard

2012 DSM Resource Acquisition Scorecard

Component	Metric	Weight	Lower	Middle	Upper
Volumes	Lifetime cubic meters (Mm^3)	92%	615.3	820.4	1025.5
Residential Deep Savings	Houses with 25% per home savings and over 11,000 cumulative m^3	4%	120	160	200
Commercial – Industrial Deep Savings	Percent over 25% bill savings	4%	40%	45%	50%

d) Commentary

14. Several factors were considered in establishing the overall Resource Acquisition target of cumulative m^3 savings.

Witnesses: P. Goldman
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J. Ramsay
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15. In the Residential Sector the available opportunity for savings through the TAPS program is declining as more and more households have been reached by the initiative. The contribution of the TAPS initiative to yearly Resource Acquisition results has been declining steadily from 14% in 2008 to 8% in 2010. In 2012 Enbridge will introduce a new initiative, Community Energy Retrofit. While this addresses the need for deeper savings, the potential number of participants is limited by the budget. The contribution to cumulative m^3 from the residential sector will continue to decline. As well, the Company's efforts in residential new construction are focused primarily on market transformation initiatives.

16. In the Commercial sector, multi-residential custom project opportunities associated with social housing will shift to the Low Income program. Also, in the Commercial sector, 35% of commercial buildings representing 50% of total natural gas consumption have already participated in Enbridge DSM programs to some degree. As well, the Company proposes to balance traditional DSM offers for prescriptive and custom incentives with a shift to performance based conservation through Energy Compass and Run It Right. Similarly, in the large new construction market, the Company will focus on recruiting builders to the Savings by Design approach. These capability building initiatives require more one-on-one customer time and it will be a challenge to achieve cumulative m^3 targets while, at the same time, delivering such customer focused efforts.

17. In the Industrial sector, about 10% of customers account for 78% of sector load. With a shift in focus from large customers to medium and smaller customers, the savings potential per customer is smaller and the cost of achieving DSM based savings is higher. The Ontario industrial sector is still feeling the impacts of a reduction in GDP growth of 20% between 2007 and 2009, both in terms of the

number of firms in the franchise area and in customer payback (and hence incentive) requirements for energy efficiency investments.

18. Considering these factors, the overall Resource Acquisition target represents a significant challenge for the Company. In comparing the 2012 cumulative m^3 100% target for Resource Acquisition and Low Income combined with the combined results for 2010 (see chart below), the target is within 8% of the 2010 results.

	2010 Actual	2012 Target	Variance
	(millions of cumulative m^3)		
Resource Acquisition		820.4	
Low Income		62.0	
Total	951.4	882..4	8%

19. The additional scorecard metrics associated with deep savings in the Residential and Commercial sectors acknowledge the importance of the achievement of deep savings.

Low Income Program Type

20. The Company's 2012 Low Income DSM Plan was developed on the following Guiding Principles:

- Carry over simplicity from the 2011 plan
- Apply lessons learned from 2010/2011 to help define the 2012 plan
- Leverage the new Board DSM Guidelines to expand the reach and scope of the Low Income program.

21. The 2012 Low Income plan expands the Company's offerings in this sector in several ways. Through the Board's DSM Guidelines, the budget is larger,

allowing for a larger suite of activities. As well, the Board's DSM Guidelines allow the expansion of the program to social housing units where tenants are not paying their own utilities. This provision applies to both single family homes and Part 3 multi-family buildings.

22. Another major change in the program is the integration of "basic" measures with "deep" measures. In low income neighbourhoods, the basic measures program (TAPS) will be used to generate leads and identify homes that may qualify for assistance with deeper measures. Part 3 buildings will be eligible for both basic in-suite measures as well as deep retrofits including efficiency improvements through Enbridge's Energy Compass and Run It Right program offerings for the multi-residential sector. For social housing providers, access to the enhanced incentives available through the Low Income program will enable more extensive and sustained retrofit activity.

a) Program Terms

23. The Program Terms noted below list those aspects of the program that were of particular interest during the consultation and that are included in the Settlement Agreement.

- Low Income Program budget = $7.025 million (including $6,120,650 in program costs)
- The Low Income budget includes an average of $300 for each single family home to treat for health and safety issues necessary to implement the energy efficiency upgrades. This average value is used, recognizing that the need, cost, and actual expense for such health and safety work will vary from home to home.

- Enbridge agrees to comprehensively treat all cost-effective opportunities in each building, defined as all measures with a TRC benefit-cost ratio of at least 0.7 (as per Board Guidelines).
- Enbridge will amalgamate the Low Income TAPS and weatherization program activities. All Low Income single family homes visited for potential weatherization will, wherever possible, receive the basic measures, (i.e., showerheads and programmable thermostats), as part of the home assessment visit. Stand-alone Low Income TAPS will no longer be offered.
- Enbridge will investigate a rental initiative for energy efficient furnace and water heaters, to be delivered by third party providers, as a way of assisting low income customers to reduce their energy consumption. The program will not involve a re-entry by Enbridge into the equipment rental business.
- Social and assisted housing (Part 3 of Division B, of the Ontario Building Code ("OBC")) buildings are eligible for equipment replacement and retrofit measures.
- The Run It Right activity will be offered to all program eligible multi-residential buildings.
- Program tracking on participants will follow ownership, (i.e., private, social and assisted housing).
- Enbridge may access the DSMVA to achieve Low Income program performance in excess of 100%.
- All parties agree that the available 10% increase in budget set forth in Subsection 8.3 of the Board's DSM Guidelines shall be used for Low Income programs only.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

b) Commentary

24. The basic Low Income budget as required by the Board DSM Guidelines would be a minimum of 15% of the total budget of $28.1 million or $4.215 million. The Board DSM Guidelines also make provision for the Low Income budget to increase by 10% of the total budget or an additional $2.81 million in the case of Enbridge. Following discussions with Intervenors Enbridge revised the Low Income budget to $7.025 million which represents the basic Low Income budget allocation plus the 10% additional. The scorecard targets at 100% have been increased on the understanding that this additional budget would be required to meet the targets.

25. The intent of the Low Income program is to capture energy savings (water heating and space heating) through the retrofit of the building, whether a low-rise residential dwelling or a multi-residential social housing building. The comprehensive approach promotes achievement of maximum cost effective savings as the building is considered as a whole and all options are considered together in developing the building's retrofit plan. As per the Board's DSM Guidelines, cost effectiveness in the Low Income sector is assessed using the TRC test where a TRC ratio of 0.7 is deemed to be cost effective.

26. Regarding the integration of TAPS and weatherization, the proposed approach is to use the "basic" measures included in the TAPS offer as a means to engage customers and encourage them to consider more comprehensive energy efficiency retrofits/improvements. The Company will work with housing providers, low income networks and other sector representatives to target low income households.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

27. For multi-residential buildings, the Company will partner with social housing providers to identify the opportunities and deliver the appropriate energy efficiency based solutions. The Company will marry the various low income incentives to its other offerings including the Energy Compass and Run it Right initiatives. Run It Right is an element of the Commercial Resource Acquisition program. Run It Right focuses on achieving energy savings by providing building operators with the tools and training necessary to operate their buildings to maximum efficiency. The supports available include operator training and rewards, funding for meter replacements, and financial support for customers using monitoring service providers; these supports are tailored to the needs of the individual customer and building. The intent is to rely on established channels and contacts to the target market to deliver a comprehensive suite of measures to as many customers as possible.

28. Higher costs are a barrier to the selection of higher efficiency water heaters and the purchase of more efficient furnaces. In 2012, Enbridge will investigate alternative financing mechanisms to address this barrier, including support for existing water heater rental programs and development of a rental program for high efficiency furnaces. In both cases, Enbridge would provide support to third party providers who offer rental equipment in the market.

29. Providers of social and assisted housing in Part 3 buildings face cost constraints that limit the amount of capital available for energy efficiency retrofit. Expanding the Low Income program to this group of housing providers will enable them to realize potential energy savings in their buildings. Social housing multi-residential buildings included in the Low Income program will be subject to Low Income adjustment factors, e.g., free ridership.

30. As with other program types, additional funding is available through the DSMVA, provided that the utility exceeds 100% of the performance target.

c) Scorecard

31. The table below provides the 2012 Low Income Scorecard.

2012 Low Income Scorecard

Cumulative Savings (million m^3)	50%	100%	150%	Weight
Single Family (Part 9)	12	17	21	50%
Multi-residential (Part 3)	33	45	56	50%
Total Cumulative Savings	45	62	77	100%

d) Commentary

32. The metric of cumulative m^3 supports the implementation of deep savings measures in participating dwellings and multi-residential buildings by encouraging measures with longer measure lives. Also, the low Income program in 2012 is a "test year" for the introduction of the Part 3 buildings. The single metric of cumulative m^3 savings allows for flexibility for the expanded program. At the same time the separate targets for Part 9 and Part 3 buildings further encourages the utility to market to both building types. Consideration may be given in future years to specific metrics for Part 9 and Part 3 buildings in addition to the metric of cumulative m^3.

33. The 2012 Low Income program represents a considerable expansion from the 2011 program but in a cost effective way. The 2011 Low Income scorecard has a target at 100% of 773,660m^3 or 17 million cumulative m^3. In contrast, the total

cumulative savings target in 2012 is 77 million m^3, an increase of more than 450% in one year and a significant challenge for the utility. In comparison, the 2012 budget of $7.025M for Low Income represents an increase of just 250% from the $2.9M budget in 2011. Enbridge expects to put a significant increase in the level of effort to achieve results in the Low Income Program Type in 2012.

Market Transformation Program Type

34. In 2012, Enbridge will launch three new market transformation programs to address market barriers and challenges in the new construction and existing residential homes markets (Savings by Design Residential and Commercial and Residential Home Labelling). The Company will also focus the delivery of the existing DrainWater Heat Recovery program to complement and support the new initiative in the residential new construction market. It should be noted that the Home Labelling program was developed in consultation with Intervenors during the discussions that led to the Settlement Agreement.

35. Following the strategic direction outlined in the Company's response to the Concentric report, and the comments from stakeholder workshops, these new market transformation programs address market barriers by building customer and industry capabilities to make informed decisions and realize potential energy savings.

36. The Savings by Design programs work to prevent lost opportunities in the new construction sector while the Home Labelling program addresses the lost opportunity associated with retrofit activity around the time of home resale. All three programs promote deep savings and the Savings by Design programs address systemic barriers in the low-rise and commercial building sectors.

Information and training are key aspects of all the market transformation initiatives including: informing customers and builders of the benefits of energy efficiency, providing information to support knowledge based decisions, and providing training to support adoption of new techniques and technologies. The Savings by Design initiatives are relationship based, in contrast with resource acquisition programs which focus on single transactions. Both the Savings by Design programs seek to recruit senior management of building companies to change their way of doing business - of designing buildings, as a way of preventing lost opportunities and realizing deep energy savings.

a) Program Terms

37. The Program Terms noted below list those aspects of the program that were of particular interest during the consultation and that are included in the Settlement Agreement.

- Market Transformation Program Budget = $4,833,600 (including $3,920,000 in program costs)
- The parties agree that the 2012 Savings by Design (Residential and Commercial) targets as set forth above will be reset for 2013 and 2014 based on lessons learned from the initial program year's experience, including Enbridge's enhanced understanding of key market participants, including builder/developers.
- Enrollment for participation in the Savings by Design program for commercial buildings will be set at a minimum building size of 100,000 square feet.
- For the purposes of assessing performance in 2012 relative to the market Transformation metrics for the residential and commercial Savings by Design programs outlined above, only builders and developers who have

"enrolled" in the program and completed the IDP process in 2012 are eligible to be counted towards the 2012 target.

- "Enrollment" is defined as a signed Memorandum of Understanding ("MOU") with a builder or developer containing a commitment to participate in the Enbridge Savings by Design program for a 3 year period which will include undertaking an Integrated Design Process ("IDP") adhering to an Enbridge approved IDP process (such as IEA Task 23 or the iiSBE developed IDP Tool) which also includes the requisite energy model, all demonstrating how to achieve at least 25% total energy savings relative to the Ontario Building Code..
- Enbridge will also provide performance incentives to builders who are enrolled in the initiative for units constructed to the increased level of performance during the commitment period. Note that builders must complete the IDP to be eligible for the follow-on building incentive. Participating builders will be expected to construct units at the higher level of efficiency as part of the MOU.
- Also, as part of enrollment, participants may be requested to allow Enbridge to feature their project in marketing and outreach materials and to use the project as part of a demonstration effort. Finally, participating builders may be asked to sit on a best practices committee that will assist in the delivery of the initiative(s) within Enbridge's franchise.
- The new construction process has a lead time to complete construction that can range from ten months to two years. In the first year of the Savings by Design initiative the objective is to establish a baseline of builders and developers who are able to design and construct buildings that are 25% better than OBC. In 2013 and 2014 metrics and targets

related to the number of units that are constructed to that level will be proposed by Enbridge.

- Enbridge is committing to ramping down financial incentives for the drainwater heat recovery program over the 2012 to 2014 period and exiting the market altogether after 2014. That commitment is reflected in the market transformation strategy outlined in the program design included in Enbridge's filing.
- In respect of the Home Labelling program, Enbridge will commission market research and analysis to support the development of a more detailed design of a time-of-sale home home labelling program for implementation in 2013 and beyond.

b) Commentary

38. The Savings by Design programs will be introduced in 2012. As with any new program, it is difficult to predict customer response. Recognizing this, the targets for 2013 and 2014 will be set later, based on the experience of the first year's operation.

39. Builders participating in the Savings by Design programs are engaged in three stages: learning how to implement the Integrated Design process in their business and then implementing the process in the design, construction, and commissioning of building projects (Part 3 buildings only). Incentives are provided at all three stages. The integration of commissioning in the Savings by Design Commercial program addresses a significant market barrier in new construction. Too often, the savings potential in a building design is not fully realized because the building has not been properly commissioned at start-up. It is expected that

the budgets in 2013 and 2014 will reflect increasing activity from builders in the implementation stage.

40. The DrainWater Heat Recovery program was first launched in 2009. It is an entry level program for homebuilders, providing an incentive for adoption of specific equipment. Enbridge will use the Drain Water program offer to recruit builders to participation in the Savings by Design program. As more builders adopt the DrainWater product, incentives will be decreased and eventually phased out entirely.

d) Scorecard

2012 Market Transformation Scorecard

Sector Program	Description	Sector Program Scorecard Value	Weight (%)	Targets Lower Band	Targets 100%	Targets Upper Band
New Construction Commercial: Savings by Design	Builder/Developers Enrolled	100%	20%	6	8	15
New Construction Residential: Savings by Design	Top 20 Builders Enrolled	20%	14.6%	1	2	3
	Top 80 Builders Enrolled	20%	14.6%	7	9	18
DrainWater Heat Recovery	Number of units installed	60%	43.8%	3,000	4,000	5,000
Total New Construction Residential		100%	73%			
Existing Residential: Home rating at time of sale	Commitments to make a provision for data field to show a home's energy rating for all homes listed by participating realtors (industry-wide commitment to include such a field on MLS or similar listing service and/or individual realtors' commitment to do so with all the homes they list on their own websites, handouts, and other consumer material)	100%	7%	N.A	Commitment from realtors collectively responsible for more than 5,000 home listing/year	Commitment from realtors collectively responsible for more than 10,000 home listings/year.
Total Market Transformation Scorecard			100%			

e) Commentary

41. In the low-rise residential sector, approximately 100 builders account for most of the new homes built. Participation in Savings by Design represents a significant

commitment on the part of participating builders. Given that the Savings by Design programs will just be launched in 2012, recruiting 5 to10% of the market in the first year represents a challenging target. In the Commercial sector, the long lead time for projects and the number of decision makers involved in a project present added challenges in recruiting builder/developers to participate in Savings by Design.

42. The target for the Drain Water program is comparable to the 2011 target.

43. The metrics for the Home Labelling program reflect the fact that the focus in 2012 will be on further development of the program design and implementation plan. At the same time, the Company will begin recruiting realtors to participate in the program.

Witnesses: P. Goldman
A. Mandyam
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S. Surdu

PROGRAM DESCRIPTIONS

1. This section provides descriptions of the programs and new program initiatives proposed by Enbridge Gas Distribution Inc. (the "Company" or "Enbridge") as part of the 2012 to 2014 Demand Side Management Plan ("DSM Plan"). Each section also provides information on program direct and indirect costs. Allocation of direct program costs to customer classes is provided in Exhibit B, Tab 2, Schedule 1. Program evaluation costs are included in Exhibit B, Tab 1, Schedule 5.

2. The programs have been grouped according to program type:

- Section 1 - Resource Acquisition Programs
- Section 2 - Low Income Program
- Section 3 - Market Transformation Programs

Section 1 - Resource Acquisition Programs

Introduction

1. The following sections describe Enbridge Gas Distribution Inc.'s (the "Company" or "Enbridge") proposed suite of Resource Acquisition Programs for 2012. They include programs in the three main sectors: residential, commercial, and industrial, with a variety of initiatives offered within each sector program. Most of these initiatives have been offered in 2011 and are continuing in 2012. Some are new efforts which the Company has developed in response to market signals and direct customer feedback. Some of the initiatives that have been successful in the past are beginning to sunset while newer initiatives are experiencing growth which is expected to continue over the three year period of the Company's Demand Side Management ("DSM") Plan.

2. For each program, the descriptions provide details on the target market, the background, the barriers, the program design and the timeline.

3. The proposed Program Costs for each Resource Acquisition program are provided in Table 1on the following page. Program Costs include direct costs which refer to incentives and indirect costs which relate to expenses such as program development, start-up, and promotion. Program evaluation costs are presented in Exhibit B, Tab1, Schedule 5.

Table 1. Resource Acquisition Programs: 2012 Program Costs

Resource Acquisition Program	Direct Costs	Indirect Costs	Total Program Costs
Residential	$2,433,000	375,000	2,808,000
Commercial	$4,580,965	3,584,824	8,165,789
Industrial	$3,054,211	1,097,000	4,151,211
Total All Sectors	$10,068,176	$5,056,824	15,125,000

Note: In 2012, $1.9 million of the Commercial budget will be dedicated to the Energy Compass/Run It Right initiative. Also, for 2012, the total budget spent on programs and activities (not including overheads) for customers in Rate Classes 110, 115, and 170 will be capped at $2.709 million, of which the total budget spent on programs and activities for industrial customers in those Rate Classes is capped at $1.797 million. These amounts are inclusive of any amounts drawn from the Demand Side Management (“DSMVA”).

4. Projected program results including gas, electricity and water savings are presented in Table 2 provided on the following page.

Witnesses: P. Goldman
A. Mandyam
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Table 2. Resource Acquisition Programs: 2012 Projected Resource Savings

Resource Acquisition Program	Annual Savings (m3)	Cumulative Savings (m3)	Annual Electricity Savings (kW.h)	Annual Water Savings (m3)
Residential	4,236,343	43,243,430	48,863	1,382,590
Commercial	30,176,215	502,710,045	1,716,229	484,949
Industrial	15,250,000	274,500,000		
Total All Sectors	**49,662,558**	**820,453,475**	**1,765,092**	**1,867,539**

Metrics and Performance Incentive

5. The Resource Acquisition Program type has one common value, lifetime natural gas savings ("cumulative savings"), at its primary metric.[1] Performance metrics related to the number and nature of participation for Residential Deep Savings and Commercial/Industrial Deep Savings are also proposed. Table 3 on the following page provides the proposed metrics and weights.

6. The maximum Shareholder incentive available for the Resource Acquisition program type is $6,440,865 for achievement of the upper band of 150% of the scorecard metric. The incentive amount is to be pro-rated for achievement levels between lower band, middle band (100%), and upper band.

[1] Lifetime savings are the product of annual savings and the assumed equipment life. These are calculated at the measure and program level and aggregated to provide the total for the portfolio.

Table 3. Resource Acquisition Programs – 2012 Performance Incentive Metrics and Weights

Component	Metric	Weight	Lower Million m^3	Middle Million m^3	Upper Million m^3
Volumes	Lifetime cubic meters	92%	615.3	820.4	1025.5
Residential Deep Savings	Number of participants with at least 2 major measures and at least 11,000 lifetime m^3 savings (average annual gas savings across all participants must be at least 25% of combined baseline space heating and water heating usage for any incentives to be earned)	4%	120	160	200
Commercial – Industrial Deep Savings	Percent of custom C&I participants with at least 25% annual gas savings	4%	40%	45%	50%

Note: Energy savings associated with capital improvement projects identified through Energy Compass/Run It Right and implemented in 2012 will be included in calculation of the 2012 cumulative m^3 program results.

7. The following pages provide the descriptions for the Company's Residential Acquisition Program.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

Resource Acquisition: Residential Program

<u>Program Name:</u> Residential Program. The Residential Program includes the following initiatives:

- Community Energy Retrofits;
- TAPS for existing homes;
- Energy Savings Kit initiative ("ESK") for residential new construction.

<u>Goal</u>: The goal of the Residential Program is to achieve energy savings in existing homes and in new single family homes and to raise awareness of the benefits of energy efficiency.

<u>Target market</u>: The Residential Resource Acquisition program targets Rate 1 residential customers.

<u>End-uses addressed</u>: Space heating and water heating

<u>Background:</u> The purpose of the Residential Program is to capture energy savings through the reduction of water use (and its subsequent reduction of natural gas use for hot water heating) and space heating demand in single family residential units. The Community Energy Retrofits initiative aims to achieve residential energy savings through a holistic approach focused on community based marketing. The traditional TAPS initiative offered to existing residential homes, and the ESK offered to the residential new construction market will capture energy savings through the reduction of hot water use and space heating through the installation of energy efficiency devices.

Focused community energy retrofit offerings have the advantage of bringing multiple interests, energy forms, and funding sources to retrofit activities. The Community Energy Retrofit initiative will be offered in communities or neighborhoods in the Enbridge Gas Distribution Inc. (the "Company" or "Enbridge") franchise with a predominance of residential customers, where the homes are older and/or high users of natural gas. This new initiative sees a strategic partnership with municipalities, electricity distributors, local agents, and contractors to deliver a neighbourhood-based home energy retrofit offer featuring "one-stop" customer service for residents including financing options.

The TAPS initiative offers no-charge installation of a variety of water and energy savings measures to existing residential customers. The existing residential market has been well-served by this initiative in the past. As such, it is highly saturated with the low flow appliances, with approximately 70% of the Enbridge franchise having already participated in the TAPS offering. This high saturation level will result in decreased TAPS targets over the remaining years of the program. Enbridge will provide the TAPS contractor(s) with a list of potential customer addresses to target for program delivery, focusing on postal codes with the highest potential.

The ESK initiative is offered to residential new construction customers through their builder for customer installation. All builders (approximately 800) within the Enbridge franchise area are offered this initiative to help promote simple products that can help reduce water and space heating. Products such as those included in the ESK and provided at no charge to the homeowner represent a cost effective way to achieve energy efficiency while also engendering the energy efficiency message for new homeowners.

Barriers:

Community Energy Retrofits:

- Capital and information costs: The cost of many energy retrofit measures requires significant investment on the part of the homeowner. There is also a cost associated with identifying potential measures related to energy efficiency.
- Prioritizing recommendations from the energy audit: Given the complexity of the various retrofit activities, it can be difficult to prioritize which ones to undertake. It is especially important to focus on key energy related measures and, where possible to piggy-back energy retrofit work on other renovation and upgrade projects.
- Identifying trusted contractors: Locating reliable renovation contractors is one task. Finding contractors with knowledge and experience in energy retrofits is an additional challenge.

TAPS:

- Non-installs and un-installs remain the single biggest barrier for the program. Some customers either refuse to accept the products or subsequently remove them after installation. While Enbridge does adjust savings calculations to reflect this, the initiative is burdened with the extra cost when contractors visit homes where customers refuse acceptance of the product or where units are provided which ultimately are not used.

ESK

- Competing priorities: For new homes, builders are often dealing with external influences such as trade contract issues which can affect timeliness and willingness to participate in Demand Side Management

("DSM") programs. As well, builders are typically more inclined to promote major upgrades (granite counters, hardwood floors, etc.) where they can earn a higher margin. Energy products or measures are generally not on their priority list. Home-buyers are often more interested in aesthetic upgrades than energy efficiency.

Program Design: For all residential resource acquisition activities, the Company will continue to explore and identify new outreach opportunities to reach the residential sector, including:

- Collaboration with municipalities and electricity Local Distribution Companies ("LDC's") to provide new channels to identify potential communities for the Community Energy Retrofit initiative;
- Exploring alternative delivery methods for the TAPS initiative utilizing customer installation or partnering with a community based delivery partner to engage the customer and pre-notify when the TAPS initiative will be delivered in their area; and
- Using the ESK initiative to create interest in Enbridge's two market transformation initiatives that target the builder market.

The Community Retrofits initiative takes a holistic approach, encompassing natural gas, water, and electricity savings measures. The neighbourhood focus will encourage high uptake levels and an efficient use of public resources to achieve energy conservation. The initiative will seek to engage residents through the use of focused educational materials, local specialized events and outreach, storefront or retail engagement, and collaboration with local schools in some aspects of delivery. The initiative uses the Eco-Energy Audit as its foundation, but provides amplified delivery through the community focus. Enbridge incentive funds will be directed at covering the cost of the initial audit and providing a performance incentive based on natural gas saved as a result of measures installed or activities undertaken as identified by the audit.

The TAPS initiative will offer a suite of energy saving measures including showerheads and aerators to residential customers. The TAPS initiative is a contractor install program, with a TAPS delivery contractor installing the showerheads in a customer’s home and leaving a kitchen and bathroom aerator for customer installation. As part of the intended sunset of the TAPS initiative over the next few years, the program will target remaining high use neighbourhoods and also consider more cost effective delivery channels.

The ESK initiative will offer to new home buyers a package of energy savings measures for self install including compact fluorescent bulbs, a programmable thermostat, and low-flow showerheads and aerators. The products are provided in a kit package to builders who make the kits available to the home buyers.

Table 4 on the following page provides a list of the program elements: eligible measures, technical assistance, training and education, the proposed marketing/communications techniques, and delivery channels.

Table 4. Residential Program Summary

Eligible Measures	Incentives	Technical Assistance	Training / Education	Marketing / Communication	Delivery Channels
Community Energy Retrofit: Thermal envelope improvements, water savings devices, high efficiency gas furnaces and water heaters, select electricity and water savings products	Enbridge incentive covers full cost of initial audit ($150) and $2/m^3 of gas saved as realized by the various retrofits	Oversight of audit process as required	Training of contractors as required, training and education of customers, students etc	Market research to support community selection, co-promotion of communications, specific community events	Through municipalities, LDCs, local Eco-Energy auditors, contractors, and schools
TAPS: Showerheads, aerators	Free product and installation	n/a	n/a	Mass Communications	Enbridge approved contractors
ESK: Showerheads, aerators, programmable thermostats, CFLs	Free product for self installation/builder installation	n/a	n/a	Direct communication to builders	Home buyers via the builders

Timeline: The initiatives offered under the Residential Resource Acquisition Program will be operated in 2012 and considered for inclusion in subsequent years, subject to a review of the remaining market potential. It is expected that participation levels will warrant continuation of some elements of the program beyond 2013.

Resource Acquisition: Commercial Program

Program Name: Commercial Program. The Commercial Program includes three program initiatives:

- Custom projects for new and existing buildings,
- Prescriptive measures for new and existing buildings, and
- A Competition to promote innovation and excellence in energy efficiency.

Note that in 2012, Enbridge Gas Distribution Inc. (the "Company" or "Enbridge") will also launch two new initiatives encouraging a continuous improvement type strategy for larger commercial customers. While launched under the Resource Acquisition portfolio, these initiatives are not anticipated to generate savings in 2012. They are described in detail as part of the Commercial Resource Acquisition Program description.

Goal: Reduce natural gas use through the capture of cost effective energy efficiency opportunities in new and existing commercial sector buildings.

Target market: The Commercial Resource Acquisition Program targets Rates 6, 110, 145, and 170, as well as new and existing commercial buildings in all segments of the commercial sector.

End-uses addressed: Space heating and water heating

Background: Enbridge offers a variety of incentive based initiatives to commercial sector customers. These initiatives include custom project incentives and a suite of "prescriptive" and "quasi-prescriptive" offerings aimed at promoting specific measures. Given the myriad of building types and end uses, ownership structures and leasing arrangements, the commercial sector is a complex market in which to deliver energy efficiency. Enbridge uses a combination of custom project funding and prescriptive measure incentives as a way of presenting a range of energy efficiency options to all commercial customers. Enbridge also proposes to target specific offers to certain segments within the commercial sector such as schools and food service for example. These approaches have been successful in the past and when combined with support for business partners that deliver energy efficiency (building auditors, consulting engineers, training institutions), the Company supports both the customer demand and the industry supply of energy efficiency products and services.

In 2012, Enbridge is proposing to amplify and expand its prescriptive offerings in response to market conditions. In particular, it is anticipated that efficiencies will be gained as some larger custom projects will be increasingly serviced through prescriptive offers. This will allow the Company's Energy Solutions Consultants to put an increased focus on benchmarking efforts such as Energy Compass and assisting customers to improve the operations of their buildings through Run It Right. For example, as part of the transition to prescriptive projects, Enbridge will also migrate many boiler projects from the custom to the prescriptive bucket as a way to simplify the process and give customers faster and easier access to incentive funding. The Company will continue to investigate new measures to determine their appropriateness for the prescriptive offering. As well, the Company expects to engage new segments and channel strategies for the commercial sector as part of an integrated marketing strategy. Finally, in 2012, the Company plans to develop a new "Conservation Competition" aimed at funding commercial customers for exemplary and innovative achievements in energy efficiency.

The year 2012 will also see revisions to the new construction offerings. As the Company expands its programming efforts under the Savings by Design initiative, it will continue to honour commitments made through the 2011 New Construction Program. As well, to better serve smaller new construction opportunities, the Company will expand its prescriptive list of measures to ensure that that all new construction opportunities have access to energy efficient measures.

Barriers: Given the diverse nature of the commercial sector, there are multiple barriers that apply. From Enbridge's experience, the key barriers include:

- Access to capital and related funding constraints, including conflicting investment alternatives;
- Lack of awareness regarding the potential savings opportunities;
- Lack of information regarding how to identify and implement potential energy savings, including accessing consulting engineers to help identify the opportunities and engaging contractors to undertake the retrofits; and
- Business cycles affect which capital investments, regardless of energy efficiency opportunity.

Program Design: The initiatives offered under the Commercial Sector Resource Acquisition program rely on a combination of outreach, education and incentives to encourage commercial customers to undertake energy efficiency investments.

Existing Buildings Custom Projects: The custom project portfolio is aimed primarily at larger users, providing them with support to identify energy saving opportunities, customized energy savings calculations, feasibility studies, and access to financial incentives. In the past, participation in the custom project portfolio has primarily come from boiler projects. In 2012, Enbridge anticipates that many boiler projects will make use of a prescriptive style incentive approach whereby the custom calculations are not required in order to provide an incentive. Rather, incentives are applied based on the boiler size (within approved sizes). The custom project portfolio will focus more on larger projects where multiple technologies are considered and the need for customized energy savings calculations remains.

Existing Buildings Prescriptive Projects: Since its initial design, the prescriptive component of the existing building Commercial Program has seen strong participation by offering easily accessible, measure specific solutions to customers (both new and existing buildings). The initiative offers a wide variety of measure-based prescriptive incentives focusing on water savings, space heating, restaurant uses, ventilation and laundry uses. The Company will also seek to expand its prescriptive offering in 2012 through the inclusion of new cost effective gas savings measures.

Part of the success of the initiative stems from the use of a targeted segment approach to the market. Opportunity assessments and market potential studies assist in identifying specific segments of the commercial market that offer un-tapped potential. This has resulted in the achievement of strong results in the food service segment through the application of pre-rinse spray valves and demand control ventilation. In 2012, the Company will continue to support this segment while expanding its marketing efforts in other sectors including health care and multi-residential.

New Construction Custom Projects: As indicated, the new construction offering is being re-designed in 2012, with a major market transformation initiative being launched focusing on the Integrated Design Process (“IDP”). The Company will continue to support the new construction market while this transition occurs by delivering the existing Design Assistance custom program (“DAP”) and prescriptive components of the existing program. Incentives for larger projects based on energy model results will continue to be accessible, while prescriptive incentives are available for smaller projects where the DAP process is not undertaken.

New Construction Prescriptive Projects: The initiative offers a wide variety of measure-based prescriptive incentives focusing on water savings, space heating, restaurant uses, ventilation and laundry uses. The Company will also seek to expand its prescriptive offering in 2012 through the inclusion of new cost effective gas savings measures.

For both custom and prescriptive offerings, the Company will attempt to engage electricity distributors and/or the Ontario Power Authority’s High Performance New Construction program (“HPNC”) to ensure that potential gas savings projects are captured when possible.

Conservation Competition: This initiative uses a pool of money as a funding incentive for leading edge projects that demonstrate significant cost effective savings potential. The intent is to offer a one-time incentive to commercial customers who undertake a project that meets certain eligibility requirements. These include the level of innovation, replication potential, amount of natural gas savings, unique aspects of the delivery approach, etc. Enbridge will develop the specific criteria as part of the initiative design and manage the application/award process. Participants will need to meet certain objectives as part of the management of their project, including full disclosure of the results.

Table 4 provides a summary of the Commercial Program elements: eligible measures, technical assistance, training and education, the proposed marketing/communications techniques, and delivery channels.

Table 4. Commercial Program Summary

Eligible Measures	Incentives	Technical Assistance	Training / Education	Marketing / Communication	Delivery Channels
Existing Buildings: Custom Projects: All cost effective measures including boilers, envelope, controls, BAS, heat recovery, other custom	$0.10/m3	Custom calculations support as required	Training, Links to contractor / engineering community	Target communications to major users, portfolio managers, sector associations	Enbridge Energy Solutions Consultants, sector associations
Existing Buildings: Prescriptive: see list	Per unit incentives for all eligible measures	N/A	Product knowledge and related information	Target communications to key decision makers, retail chains, sector associations	Enbridge Energy Solutions Consultants, channel reps, business partners
New Construction: Custom (Legacy projects)	$0.20/m^3	N/A	Product knowledge and related information	Target communications to key decision makers (design community)	Enbridge Energy Solutions Consultants, sector associations, HPNC, Enbridge marketing team
New Construction: Prescriptive	Per unit incentives for all eligible measures	N/A	Product knowledge and related information	Target communications to key decision makers and specifiers	Enbridge Energy Solutions Consultants, sector associations, HPNC, Enbridge marketing team

Timeline: The initiatives offered under the Commercial Program will be operated in 2012 and considered for inclusion in subsequent years, subject to a review of the remaining market potential. It is expected that participation levels will warrant continuation of the program beyond 2013.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

Resource Acquisition: Commercial Program
Energy Compass and Run It Right Program Initiatives

Program Initiative: Energy Compass and Run It Right

Goal: Recruit building owners to long term commitment to improving energy performance of buildings in their portfolio through in-house benchmarking and continuous operational improvements. This includes support for energy monitoring services and related analysis, re-commissioning and energy savings opportunity assessments.

Target market: Property managers of large commercial, multifamily and institutional buildings, including property managers with multiple buildings. For the purposes of this program description, all of these sectors will be referred to as “commercial”.

End-uses addressed: Space and water heating

Background: The acquisition and analysis of detailed energy data allows building operators and managers to make strategic “data-driven” decisions regarding energy savings and capital investments. Modern metering and related communications tools and data analysis capability facilitates that decision making. Potential savings through the use of a holistic data-driven energy management system can be dramatic, with operational savings alone that can be greater than 10%, and it is those operational savings that represent a key feature of Enbridge Gas Distribution Inc.’s (“the “Company” or “Enbridge”) proposed initiative.

Over the past three years, Enbridge has witnessed increased marketplace interest and requests for consumption data. This has come from various sources including:

- Customers wishing to receive site specific energy data;
- An increased number of requests for meter replacements or sub metering as a way of obtaining more granular consumption data;
- An increased number of requests for meter access to install downstream hardware capable of capturing hourly pulse data;
- Municipal requests for aggregated postal code consumption information to help establish energy and carbon reduction targets; and
- Sector based, peer to peer style initiatives using benchmarking and supporting analyses

These requests have been somewhat ad hoc and generally have not been a part of a larger understanding of energy management for a building or a portfolio of buildings. Few, if any holistic solutions that address all of these activities currently exist in the marketplace. There are service providers, including consulting engineers and energy service companies who typically focus on specific, but not all the activities associated with a comprehensive energy solution for a building. This represents a potential opportunity to deliver a more robust and comprehensive energy strategy for commercial buildings, particularly larger buildings or large portfolios of buildings.

Barriers: In terms of industry capacity, some companies and organizations offer very specific compartmentalized services. Holistic solutions are not readily available. Considerable marketplace barriers exist, including:

- Customers are not aware of the opportunity or if they are, are not convinced about the magnitude of the potential savings;
- Energy management is not a core business activity and customers do not have in-house expertise to undertake the required activities;
- Monitoring service providers who typically do not offer a complete package of analysis;
- Monitoring services that may only be cost effective for a limited type and size of customer;
- Monitoring services that do not provide recommendations for appropriate energy solutions to address excessive consumption;
- Re-commissioning agents with either limited analytical services or limited interest in continuous monitoring and sustained energy savings;
- Energy profiling is often undertaken by vendors whose financial interest is in selling capital improvements rather than operational improvements;
- Utilities have traditionally not been viewed as energy partners by commercial sector customers for the operations of their buildings.

Program Design:
Approach: Towards Performance Based Conservation
Using data to first identify opportunities and then as part of a continuous feedback loop to making ongoing operational and capital decisions is an important step towards *performance based conservation.* Such an evolution is a critical next step to migrate away from more traditional “estimated savings” approaches to energy efficiency.

Enbridge’s traditional approach to Demand Side Management (“DSM”) has tended to focus on assisting customers to realize energy savings through capital investments in new technology where the “cause and effect” relationship between the investment, the savings and Enbridge's subsequent gas savings claim were simpler to establish. While this approach has served our customers well, it has also left some savings potential un-addressed, particularly that associated with operational improvements where no major capital investments were required.

To be effective at overcoming current market barriers to performance based conservation requires investments in time and resources for the purposes of creating base lines, helping customers understand their consumption, providing operator training and technical solutions, and reporting and recording cause and effect changes to identify and capture savings. These are not activities that commercial customers, by themselves, are inclined to undertake for the reasons outlined above.

Through the initial design and development of the Energy Compass (benchmarking) and Run it Right (operational improvements) initiatives, Enbridge has developed an understanding of what customers require to identify and strategically implement improvements in their facilities. These programs build on our history of working with customers to identify capital investment and operational improvement projects and represent an evolution in the relationship with the customer from intermittent engagement related to specific capital investment and operational improvement opportunities to strategic and constant energy management partner. Through its expertise and unique access to a variety of delivery agents, Enbridge can identify and stimulate appropriate energy solutions provided by business partners. These service providers include engineering firms, re-commissioning agents, contractors, manufacturers, and monitoring service providers.

Enbridge has an important role to play in knowledge development, opportunity identification, measurement, engineering analysis and assisting customers with action and implementation. By creating these added value partnerships and offerings, customers, business partners and Enbridge have a vested interest in working together towards measured savings, provided regulatory framework barriers are removed.

To move the commercial marketplace towards data driven decision making and to eventually transform it, the 2012 DSM Plan proposes an increase in funding of performance based initiatives allowing Enbridge to take an increasing role in the steps required to move the market place towards performance based conservation.

Overview of the Initiatives:

This section provides an overview of Energy Compass and Run It Right. The following section, Initiative Elements, provides additional detail on the incentives and supporting activities for customers.

a.) Benchmarking and Energy Compass Program

Benchmarking is an exercise wherein a building's energy performance can be compared to similar types of buildings either within a company's portfolio or in comparison to others. It facilitates energy accounting, comparing a facility's energy use to similar facilities to assess opportunities for improvement, and quantifying/verifying energy savings. Typically, benchmarking is first used to identify poor performing buildings. Once these are identified, operational improvements can be made as a first priority. Capital investments can then be considered and directed to the most appropriate buildings. In this way, operational and capital expenditure can be prioritized based on their return on investment or other financial criteria.

Enbridge proposes to expand its benchmarking initiatives, engaging more of the commercial sector so that customers begin to understand their patterns of energy consumption and consider ways to lower energy use. This necessitates further investments in benchmarking based activities. To identify the most cost effective solutions, the Company has developed a variety of its own tools including a multi-variable regression model that reviews area, occupancy, building age, number of floors, number of suites and other variables to provide a comprehensive perspective on building performance. In 2010 to 2011, this tool was tested in the market with a selection of key larger building portfolio managers and over 140,000,000 square feet were analyzed.

Feedback from this exercise was very positive and results were so encouraging that Enbridge proposes that all customers be targeted and encouraged to participate in this initiative starting in 2012. This program can be used for all commercial sectors but has particular appeal to sectors where major building portfolios exist. Enbridge will also continue to sponsor and subsidize other industry benchmarking initiatives that are already targeting specific sectors such as healthcare and schools.

b.) Operational Improvement and Run It Right Program

The Run it Right program offer is an evolution of Enbridge's Monitoring and Targeting or Operational Improvement Program. With its fresh new branding, this initiative will contain some improvements over previous years to include operator training and rewards, best practices checklists, additional funding and improved processes for meter replacements, financial support for customers using monitoring service providers, contractors and automated report generation.

In 2011, Enbridge created a refined process for claiming operational improvement savings and providing technical and data analysis for customers. The Company is investigating the development of applications that will allow customers to use their mobile devices as an onsite reference for available best practice solutions and as a tool to record operational changes.

From a technical perspective, the program has been further improved and is based on a foundation of best practices identified in a study commissioned by Enbridge in 2010. Enbridge has also made this program offer available to Union Gas Ltd ("Union") so that a consistent offer is available in the marketplace.

According to a study undertaken by Marbek Resource Consultants Ltd[2] in 2009, re-commissioning/operational improvements are one of the most significant opportunities for natural gas savings in the commercial sector. Re-commissioning is a systematic process of ensuring building systems are operating according to their intended performance characteristics and the building needs. Re-commissioning often identifies operational improvements which represent very cost effective gas saving opportunities in buildings.

[2] Natural Gas Energy Efficiency Potential: Update 2008, Residential, Commercial and Industrial Sectors Synthesis Report. Exhibit B, Tab 2, Schedule 7.

Examples of operational improvement measures are: boiler tune ups, re-calibration of damper controls, schedule changes, compartmentalizing space heating loads within the building, and turning off equipment when not needed etc.

In 2012 Enbridge proposes to develop tools for internal use that allow for daily monitoring and automation of consumption analysis that identifies customer's excessive consumption. These tools will be used to expand support to the re-commissioning marketplace. Once customers are more familiar with data driven decision making, the longer term goal is to migrate larger customers to use daily monitoring on their own or through service providers as a way to achieve ongoing, "deeper" savings.

Initiative Elements:

a.) Energy Compass

Energy Compass provides a cost effective way to rank buildings on several key parameters (e.g.; Area, Occupancy, Age, number of floors, number of suites)

Energy Compass has a number of key elements:

- Customized Energy Plan per portfolio;
- Enbridge site examination of the highest energy intensive buildings
- Specific Recommendations for each building and portfolio; and
- Links with the contractor/engineering community for implementation.

Customized Energy Plan per portfolio: Every participating portfolio will receive a customized Energy Plan that documents each building in the portfolio. There are two benchmarks available in the Energy Plan:

Benchmark of buildings relative to other buildings in the portfolio and Benchmark of portfolio relative to other participants in Energy Compass, once a statistically significant number of participants take part in the program.

Enbridge site examination of the highest energy intensive buildings: Enbridge Energy Solutions Consultants will visit all the high energy intensive buildings after the benchmarking analysis is completed. They will collect building attributes (e.g., boiler efficiency, ventilation schedules, building control) and document them as part of the Energy Plan. (This can be done in conjunction with the customer's service provider.)

Specific recommendations for each building and portfolio: After the Benchmarking analysis is complete, Enbridge will examine its DSM database, and identify which buildings have received incentives and for what technology. Based on this analysis, Enbridge can help identify specific technologies that the customer may implement in the future.

Links with the contractor/engineering community for implementation: Enbridge has established a very strong network of mechanical contractors and consulting engineers that can be leveraged to help customers implement capital retrofit or operational retrofit measures.

Where customers have undertaken benchmarking through other avenues, Enbridge will provide the same range of services above.

b.) Run it Right

Run it Right focuses primarily on providing customers with the kind of data, analysis, information, and tools that will allow them to make informed decisions about managing their energy use. Run it Right has a number of key elements:

- Meter replacements where warranted;
- Operator training and education on operational re-commissioning activities;
- Operator recognition rewards;
- Enhanced tools for monitoring/analyzing effects of operational improvements; and
- Enhanced tools for communicating changes at an operator level.

Meter replacements: Increased investments are planned to ensure that customers who will be using monitoring service providers have meters that provide daily data outputs that are critical to the energy analysis.

Operator training: Training will be provided to property management firms. The training will be based on best practices supported through program literature. Measure specific literature is also provided.

Operator recognition rewards: Rewards will be provided through organizations that implement energy improvements as part of their operator performance objectives. These rewards will help to raise the profile of the initiative while encouraging users to do more.

Monitoring/Analyzing re-commissioning activities: Through the Run it Right initiative, Enbridge will provide analytical, technical, and financial support to large volume customers who implement low cost/no cost operational measures. Enbridge participants who do not have a third party performing analysis will be provided with analytical support. Enbridge will also provide technical support for implementing operational changes using its customized check list, and operational improvements training.

Enhanced tools for communicating changes at an operator level: New communications platforms enable instant feedback and real-time monitoring and control of energy using equipment. Enbridge will provide funding support for the roll-out of specific applications.

Table 6 on the following page provides a list of the eligible measures, technical assistance needs, training and education needs, the proposed marketing/communications techniques, and delivery channels.

Table 6. Energy Compass/Run it Right Activity Summary

Eligible Measures	Incentives	Technical Assistance	Training / Education	Marketing / Communication	Delivery Channels
Energy Compass	Energy Plan, site visit	Customized energy plan per portfolio, Site visit assessment, Recommendations	Training links to contractor and engineering communities	Target communications to portfolio managers, sector associations	Enbridge Energy Solutions Consultants Bench-marking service providers, sector associations
Run It Right	Meter replacement, support for monitoring, support for communications tools	Tools for monitoring and analyzing effects of operational improvements	Operator rewards	Target communications to portfolio managers, sector associations	Property Management firms, Controls companies, Monitoring service providers, sector associations

Timeline: The program will be operated in 2012 and considered for inclusion in subsequent years, subject to a review of the remaining market potential. It is expected that participation levels will warrant continuation of the program beyond 2013. Note that natural gas savings are anticipated as occurring starting in 2013. These will be reported as part of the 2013 evaluation activities.

Resource Acquisition: Industrial Program

Program Name: Industrial Program.

In the Industrial sector the Continuous Energy Improvement ("CEI") initiative encompasses the industrial sector custom project offering. In 2012, Enbridge Gas Distribution Inc. (the "Company" or "Enbridge") will develop prescriptive incentives for the industrial sector. Together, these initiatives present a complete package of Demand Side Management ("DSM") program initiatives for the industrial sector.

Goal: Support industrial customers to achieve energy savings through a Continuous Improvement approach.

Target market: Plant technical staff, supervisors, and management of industrial facilities. Target Rate Classes: The Continuous Improvement Resource Acquisition industrial program targets Rates 6, 110, 115, 135, 145, and 170.

End-uses addressed: Industrial process heat, space heating and water heating.

Background: The acquisition and analysis of detailed energy data allows plant and facilities operators and managers to make strategic "data-driven" decisions regarding energy savings and capital investments. Modern metering and related communications tools and data analysis capability facilitates that decision making. Potential savings through the use of a holistic data-driven energy management system can be dramatic. Marrying those opportunities to incentives available for capital investments through the Custom Project incentive stream presents a holistic approach to achieving energy savings in the industrial sector.

Through Enbridge's significant involvement in the industrial sector, the Company has identified increased marketplace interest and requests for consumption data. This has come from various sources including:

- Customers wishing to receive site and process specific energy data;
- An increased number of requests for sub metering as a way of obtaining more granular consumption data; and
- An increased number of requests to install downstream hardware capable of capturing pulse data.

The use of Custom Project incentive funding in the past has been extremely successful, engaging more than 500 large customers and capturing significant cost effective energy natural gas savings. In recent years, Enbridge has noted a decline in the number and depth of savings coming from larger projects. This relates both to the success of the program to date and to a number of macro-economic impacts relating to the downturn in the economy and the movement of many industrial facilities to off-shore locations. This necessitates a realignment of the program strategy in keeping with the new realities, specifically greater targeting of small to mid-size operations and more flexibility in the incentives offered. As such, in 2012 Enbridge proposes to increase its custom incentive to $0.10/m^3 and expand its prescriptive offering to include more measures. Greater segment focused marketing activities aimed at the smaller facilities will augment the marketing efforts supporting the CEI initiative for larger customers.

Note that the CEI program initiative acts as a gateway to the custom project incentives. Natural gas savings are reported under the Custom Project banner.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

Barriers:

Barriers unique to the industrial sector relate to technical capacity, economic conditions and the financial perspectives of customers. The barriers in the industrial sector include those listed below.

- The analysis of industrial facilities is complex, requiring specialized equipment and expertise. It must encompass more than just the boiler room to include an examination of production processes which are unique to specific industries. Many industrial clients do not have the resources or expertise required to undertake extensive monitoring, data collection and analysis to understand potential areas of focus, methods of amelioration and solution implementation.
- Customers are not aware of the opportunity or if they are, are not convinced about the magnitude of the potential savings.
- Energy management is not a core business activity and customers do not have in-house expertise to undertake the required activities, or the ability to acquire these resources.
- Larger customers require on-going support to identify and prioritize potential savings and to develop the requisite business case to “sell” the project internally.
- Overall, there is a lack of energy efficiency technical capacity in the industry, including too few, industry focused Certified Energy Managers (“CEMS”).
- The current economic climate has many industrial customers focused on survival rather than investing in long-term energy solutions. Staff reductions and related resource constraints have removed key energy manager expertise.

- Decisions made relating to process improvements are often taken at corporate head offices outside Ontario, not locally.
- Natural gas prices have dropped by 48% relative to 2008 levels. This has tended to work against energy efficiency by relieving customers of a sense of urgency associated with controlling energy costs. As well, it has lengthened the payback period of natural gas focused energy efficiency projects. Previously financially attractive projects may no longer meet the customers' investment criteria. Interest in energy efficiency often ebbs and wanes as energy prices increase and decrease.
- In addition to the actual costs of implementing energy efficiency measures and processes, obtaining energy and related operational information needed to set energy management plans and priorities can be costly.

Program Design:

Approach: Towards Performance Based Conservation

Using data to first identify opportunities and then as part of a continuous feedback loop to making ongoing operational and capital decisions is an important step towards ***performance based conservation.*** Such an evolution is a critical next step to migrate away from more traditional "estimated savings" approaches to energy efficiency.

Enbridge's traditional approach to DSM has tended to focus on assisting customers to realize energy savings through capital investments in new technology where the "cause and effect" relationship between the investment, the savings and Enbridge's subsequent gas savings claim were simpler to establish. While this approach has served our customers well, it has also left some savings potential un-addressed, particularly that associated with operational improvements where no major capital investments were required.

To be effective at overcoming current market barriers to performance based conservation requires investments in time and resources for the purposes of creating base lines, helping customers understand their consumption, providing operator training and technical solutions, and reporting and recording cause and effect changes to identify and capture savings. For many of Enbridge's industrial customers, these are not activities that are central to their business.

With a legacy of successful programming initiatives aimed at the industrial sector, Enbridge has developed an understanding of what customers require to identify and strategically implement improvements in their facilities. This solid history of working with customers to identify capital investment and operational improvement projects brings the opportunity to further our customers' energy management experience by delivering a holistic set of energy management support services aimed at maximizing cost effective energy savings opportunities. Through its expertise and unique access to a variety of specialists, Enbridge can identify and stimulate appropriate energy solutions provided by business partners. These service providers include engineering firms, contractors, manufacturers, and monitoring service providers.

Enbridge has an important role to play in knowledge development, opportunity identification, measurement, engineering analysis and assisting customers with action and implementation. By creating these added value partnerships and offerings, customers, business partners and Enbridge have a vested interest in working together towards measured savings.

To move the industrial marketplace towards data driven decision making, the 2012 DSM Plan proposes funding initiatives focusing on *performance based conservation* that are offered to industrial customers alongside our Custom and Prescriptive incentive offerings.

Elements:

As described above, customers experience barriers to adopting energy efficiency activities and equipment at each stage of the process, from identification of opportunities through to implementation. Enbridge has structured the CEI initiative to address the market barriers encountered at each stage of the process:

- Knowledge of energy use;
- Opportunity Identification;
- Measurement;
- Engineering Analysis; and
- Action and Implementation.

Knowledge development:

- *Generic and site specific education and technical training seminars* to increase the expertise of customers concerning energy use. Planned target areas for training include:
  - process combustion training;
  - boiler efficiency training;
  - steam utilization;
  - heating and ventilation training;
  - ISO 50001;

  - operator training; and
  - statistical analysis support.
- *An In-house Co-op Student Sponsorship* where Energy Solutions Consultants assist college or university students to provide practical experience in the field.
- *Training sponsorship* of external organizations in their delivery of educational events and training seminars.
- *An online forum* for customers and business partners, comprising of a technology database, case studies, forum, presentations and other information.

Opportunity identification:

- *Energy assessments* conducted by Enbridge.
- *Financial support* - to customers for detailed assessments provided by 3rd parties (50% up to $10,000).
- *Design reviews* - provided by Enbridge;
- *Financial support for on-site energy engineers* – for large customers (15,000,000 m^3 or equivalent annual natural gas use & financially supported by Enbridge).
- *Development of Energy Management Plans* – to help customers to track energy use and costs, target significant energy use for improvement, create accountability, and most importantly engage participation from the entire organization.
- *Management consultation (ISO 50001)* – Enbridge will assist interested manufacturers in implementing the ISO 50001 Energy Management Standard in industrial plants.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

Measurement:

- *Information quantification and gathering solutions and options.*
- *Supporting tools and incentives* (up to 50% of the cost to a maximum of $10,000) to customers and/or business partners to overcome market barriers to obtaining quantitative energy and related information.

Engineering analysis:

- *Enbridge analytical services and assistance* to customers who do not have the resources needed to conduct financial, technical, and enterprise risk evaluations for potential projects.

Action and implementation::

- *Financial Assistance* – planned incentives of up to $0.10/m^3$ up to $100,000 for larger custom projects and (up to) $0.20/m^3$ for smaller "prescriptive" projects. Note that in 2012, Enbridge will undertake to expand the list of prescriptive offerings to include a wider range of measures that will be specifically targeted at small to mid size industrial customers. The success of the initiative will stem from the use of a targeted segment approach to the market. Opportunity assessments and market potential studies assist in identifying specific segments of the industrial market that offer un-tapped potential. In 2012, the Company will focus its marketing efforts on capturing greater activity from the small to mid-size industrial customers through segment targeted campaigns using the prescriptive measure incentives.
- *Business Partner Network* – connecting customers with industry trade professionals.

Timeline: The program will be operated in 2012 and considered for inclusion in subsequent years, subject to a review of the remaining market potential. It is expected that participation levels will warrant continuation of the program beyond 2013.

Table 7 on the following page provides a list of the eligible measures, technical assistance, training and education, the proposed marketing/communications techniques, and delivery channels.

Table 7. Industrial Program Activity Summary

Stage	Incentives	Technical Assistance	Training / Education	Marketing / Communication	Delivery Channels
Knowledge Development	Co-op student sponsorships		General workshops Co-op students sponsorships Training sponsorships On line forum Other outbound communications (industry newsletter and webinars)		Energy management firms Controls companies Monitoring service providers Manufacturers
Opportunity Identification	For detailed assessments by 3rd parties (50% up to $10,000 Support for on-site energy engineers	Energy Assessments (by EGD) Design reviews (by EGD) On-site energy engineers Development of energy management plans Consultation re: ISO 50001			
Measurement & Quantification	Support for up to 50% of costs to a maximum of $10,000	Solutions and options – recommendations re: appropriate approach (by EGD) Supporting tools (30 new or existing meters per year)		Direct to large users. Sector focused materials to sector associations	Energy management firms Controls companies
Engineering Analysis	Financial support for detailed analysis	Analytical support (EGD staff) Trial of technology, pilot projects, on-site testing			Monitoring service providers
Action and Implementation	Planned incentives up to $0.10/m3 up to $100,000 for custom		Connecting customers with business partner network	Target communications to larger customers, sector associations	Enbridge Energy Solutions Consultants, sector associations
	Planned incentives up to $ $.20/m3 for prescriptive		Connecting customers with business partner network	Target communications to smaller customers, sector associations	Enbridge Energy Solutions Consultants, sector associations, Manufacturers of prescriptive measures

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

Section 2 - Low Income Program

Introduction

1. The following section describes Enbridge Gas Distribution Inc. (the "Company" or "Enbridge") proposed Low Income program. The Low Income program includes offerings in the two main target markets: "Part 9" residential single family homes and "Part 3" multi-unit residential buildings.

2. Enbridge has been directed by the Ontario Energy Board (the "Board") to fund its Low Income program by allocating 15% of the total Demand Side Management ("DSM") budget to the Low Income portfolio. The Board further made available an optional 10% of the total DSM budget to fund even greater DSM activity in the Low Income program. These amounts are shown in Table 1 below.

Table 1. Low Income Budget

Program Type	Program Budget	Overheads	Total
Low Income - Base budget (15%)	$3,765,000	$450,000	$4,215,000
Additional 10%	$2,255,650	$554,350	$2,810,000
Total Low Income	$6,120,650	$904,350	$7,025,000

3. With the support of the various low income stakeholder groups, Enbridge has developed a program portfolio that proposes to use the entire budget available ($7.025 Million) for the purposes of delivering a comprehensive low income focused set of DSM activities. Table 2 on the following page presents the proposed Program Costs including direct costs which refer to incentives

and indirect costs which relate to expenses such as program development, start-up, and promotion. Program evaluation costs are presented in Exhibit B, Tab 1, Schedule 5.

Table 2 Low Income Program Costs and Total Budget

Low Income Program	Direct costs	Indirect costs	Total Program Costs	Overheads	Total Low Income Program
Single Family	$3,285,900	$510,000	$3,795,900		$3,795,900
Multi-Residential	$1,152,250	$1,172,500	$2,324,750		$2,324,750
General				$904,350	$904,350
Total Low Income	$4,438,150	$1,682,500	$6,120,650	$904,350	$7,025,000

4. The following pages provide descriptions for the Company's Low Income Program.

Low Income Program

Program Name - Low Income Program

Goal: To capture energy savings through the reduction of hot water use and space heating demand in low income single family homes and multi-family social housing units through the installation of water saving measures, space heating measures and thermal envelope improvements.

Target Market: Rate 1 and Rate 6 customers. Home owners and tenants living in low-rise homes within the Enbridge Gas Distribution Inc. (the "Company" or "Enbridge") franchise that are in need of assistance with their energy costs and social housing units where tenants are not paying their own utilities (both single family homes and multi-family buildings).

End-uses addressed: Water heating and space heating

Background: According to information compiled by Low Income Energy Network ("LIEN"), approximately 15% of Ontario's population is living at or below the "poverty line" and 23% of tenant households pay their own utilities. Overall 45% of Ontario households pay 30% or more of their household income on shelter costs (which include utility costs).

Enbridge customers are identified as low income if they have a household income which is at 135% or below Statistics Canada's pre-tax, post transfer Low-Income Cut-Off ("LICO"). The Company estimates that approximately 10% (based on 1.5 million residential Rate 1 customers) are considered "low income" given this definition. This includes customers who live in both single family and multi-family buildings.

The eligibility criteria to access the Enbridge Low Income initiatives are as listed below.

- Participants must be located in Enbridge franchise area.
- Participants are identified as low income (have a household income which is at 135% or below Statistic Canada's LICO; based on a community size of greater than 500,000 residents)
- Participants must have a natural gas fired space heating system (i.e., furnace or boiler) and/or gas-fired water heater.
- Participants must be homeowners or tenants living in individually metered Part 9 buildings (3 stories or less) and Part 3 buildings (4 stories or more) which includes all of the following: row/townhouse units, low rise two, three and four-plex residences, semi-detached and single detached residences, and high-rise multi-residential social housing units.

Barriers: This Low Income sector can be difficult to access through traditional DSM activities for a variety of reasons.

- Financial - Initiatives that generally require a customer to purchase a more efficient piece of equipment to receive a rebate present financial barriers for low income customers.
- Health and safety issues – In several cases, low income homes are in substandard housing conditions that require repair, e.g., electrical, heating and ventilation, structural, to bring these at least to a minimum health and safety level. This will need to be addressed prior to any weatherization work in the home to ensure optimal energy efficiency savings and/or that health and safety issues are not worsened.

- Awareness – Low income customers may face challenges with language barriers, literacy issues and access to information regarding the benefits of energy efficiency.
- Reluctance to self-identify as needing assistance – This presents a related difficulty for the utility in identifying low income customers within the franchise area.
- Lack of trust – Even with the offer of a “free” initiative there are concerns that “nothing is free” in todays world.
- Split incentives – The Enbridge initiative is available to tenants who pay their own utilities but tenants require landlord consent to receive measures or retrofits.
- Delivery agent constraints – Enbridge currently leverages social agencies and Winter Warmth/LEAP funding agencies to help promote these initiatives. Agency staff often faces a number of important issues and energy efficiency initiatives can be a lower priority.
- Low Income customers are often tenants and can be a transient group – An application may be received for support but by the time the application is processed and Enbridge attempts contact, the tenant has moved on.
- Cost – providers of social and assisted housing face budget constraints that limit the funds available for energy efficiency retrofit and equipment replacement.

Program Design: As outlined above, the low income sector can be difficult to access through traditional Demand Side Management (“DSM”) programming activities. There are a variety of barriers at play, including financial, customer awareness and customer access. The sector typically requires targeted and specific outreach activities and direct installation of the various measures. In 2012, the Low Income offering will be expanded to include both a greater emphasis on achieving deeper savings through the use of weatherization measures and a targeted effort towards addressing comprehensive energy efficiency needs in multi-residential social housing buildings.

Enbridge will offer a suite of “basic measures” including the TAPS water savings measures for single family homes and in-suite measures including showerheads and reflector panels for multi-family units. This basic measure component of the initiative will provide free installation of a selection of measures including low flow showerheads, faucet aerators, programmable thermostats and reflector panels (multi-family units Part 3 buildings). The basic measure component will be used to generate leads and identify potential homes that may qualify for deeper weatherization type measures in low income neighbourhoods.

The “deep measure” offerings will include weatherization and/or furnace replacement in single family homes and building retrofit or major equipment replacement projects for multi-family buildings. The multi-family buildings will also be eligible to participate in Enbridge’s Energy Compass and Run it Right initiatives offered through the commercial sector DSM portfolio. This integration offers synergies around aspects of delivery, communication and outreach.

The weatherization component of the initiative features a home audit coupled with financial incentives aimed primarily at significantly improving the thermal envelope characteristics and space heating in low income homes. Technologies may include attic, wall and basement insulation, door and window caulking, and outlet gaskets. In homes where health and safety repairs are a pre-requisite to implementing energy efficiency measures such as dealing with moisture problems in a crawl space prior to insulation, the program will fund such repair work prior to weatherizing the home. Enbridge will contract with service providers experienced in energy efficiency audit and retrofit delivery activities.

In the past Enbridge has relied heavily upon delivery partners and identified social agencies to promote its low income initiatives to customers. Enbridge will carry out additional analysis of its in-house database to help identify low income neighbourhoods, with age-appropriate housing stock to target for future outreach and broadened program participation. As well, external research may be undertaken to identify neighbourhoods with a higher proportion of lower income households for further targeted outreach activities.

In 2012 the Company will continue to explore and identify new outreach opportunities to reach the sector, including:

- Collaborate with municipalities and electricity Local Distribution Companies ("LDC's") to open new channels to identify and connect with the low income customers;
- Continue to engage Winter Warmth Program/ Low Energy Assistance Program ("LEAP") funding agencies to define a process to automatically enrol emergency funding recipients in the low income initiatives;

- Consider translating of materials to predominant languages spoken in the targeted communities to help address the barriers experienced;

- Continue to develop relationships with municipalities and other relevant business partners, such as Social Housing Services Corp. (“GLOBE/SHSC”), Social Planning Network of Ontario (“SPNO”), and LIEN to help promote our initiatives; and
- Investigate an initiative to subsidize furnace and water heater replacements utilizing existing third party providers already in the marketplace.
- Explore opportunities to extend the Low Income program to privately-owned multi-residential buildings.

Table 2 on the following page provides a summary of the program elements: eligible measures, incentives, technical assistance, training and education, marketing, and delivery channels.

Table 2: Low Income Program Summary

Eligible Measures	Incentives	Technical Assistance	Training / Education	Marketing / Communication	Delivery Channels
Residential Water savings devices, thermal envelope improvements, high efficiency gas furnaces	Full Eco-energy audit(s), free water and weatherization measures Health and safety repairs as warranted.	Oversight of audit process as required	Training of contractors as required, training and education of customers	Targeted marketing to associations and muncipalities	Low income associations, Winter Warmth, municipalities, not-for-profit community based organizations, and other LDCs as appropriate
Multi-residential: Water savings devices, reflector panels, programmable thermostats, Custom measures including boiler retrofits, weaterhization, controls etc	Free basic measures, Full project financing for custom measures, access to Energy Compass and Run it Right	Custom project identification and benchmarking	Training of contractors and consulting engineers as required, training and education of customers, resident and building manager / operator training	Targeted marketing to social housing agencies and housing providers, associations and muncipalities	Social housing agencies and housing providers, associations, not-for-profit community based organizations, and muncipalities

Timeline and Trajectory: The initiative will be operated in 2012 and considered for inclusion in subsequent years, subject to discussions with low income delivery partners and Intervenors.

Projected Results: Table 3 on the following page provides the projected annual and cumulative natural gas savings and the annual water savings. Water savings occur as co-benefits from the water savings devices installed via the TAPS and in-suite measures.

Table 3. Annual and Cumulative Gas Savings and Annual Water Savings

Low Income Initiative	Annual Savings (m3)	Cumulative Savings (m3)	Annual Water Savings (m3)
Single Family	810,147	16,989,070	14,082
Multi-Residential	3,089,900	45,474,000	29,835
Total Low Income	3,900,047	62,463,070	43,917

Metrics and Performance Incentive: The Low Income portfolio has lifetime natural gas savings ("cumulative savings") as its primary metric.[1] Performance metrics are provided for the two components of the program: Part 9 single family homes and Part 3 multi-residential buildings. Each component has an equal weighting. Table 4 provides the proposed metrics and weights.

Table 4 Performance Incentive Metrics and Weights

Component	Weight	Lower Million m^3	Middle Million m^3	Upper Million m^3
Single Family	50%	12	17	21
Multi-Residential	50%	33	45	56
Total Low Income	100%	45	62	77

The maximum shareholder incentive is $2,375,000 for achievement of the upper band of 150% of the scorecard metric. The incentive amount is to be pro-rated for achievement levels between lower band, middle, and upper bands.

[1] Lifetime savings are the product of annual savings and the assumed equipment life. These are calculated at the measure and program level and aggregated to provide the total for the portfolio.

Section 3 - Market Transformation Programs

Introduction

1. The following four sections describe Enbridge Gas Distribution Inc. (the “Company” or “Enbridge”) proposed suite of market transformation programs for 2012. They include two entirely new programs, one program which is a continuation of a 2011 offering and one program which is an evolution of a previous offering. These are:
   - Drain Water Heat Recover (“DWHR”) – Continuing from 2011,
   - Savings By Design (“SBD”) for Residential New Construction – new initiative,
   - Home Labelling – new initiative, and
   - SBD for Commercial New Construction – evolution of Design Assistance Program (“DAP”).

2. Each program has been developed based on the market barriers and needs and, where appropriate, includes activities aimed at both the up-stream “supply” of energy efficiency and the down-stream customer demand. The programs also attempt to leverage other Demand Side Management (“DSM”) activities that the Company is undertaking and its existing contact points to the market. The intent with each of these programs is to work within the existing supply channels and markets and provide interventions that address the specific barriers and needs.

3. As part of the research and background analysis that supports these designs, Enbridge engaged in a series of stakeholder sessions with its various customer groups. The Company further sought out specific insights and

expertise during the design phase from organizations and individuals who are active in these markets. This information served to inform the eventual designs of the initiatives and these contacts will be critical delivery partners for the programs as they are launched in 2012.

4. For each program, the descriptions provide details on the target market, the background, the barriers, the program design, the timeline and trajectory, the metrics that will be used to evaluate the initiative and the proposed performance incentive. Where possible, Enbridge has attempted to provide best estimates of potential longer term outcomes and results. It is noted that these are speculative and are presented for illustrative purposes only.

5. In 2012, a top priority is the development of program logic models and related support materials which will provide greater specificity for immediate and longer term activities and outcomes. Market research is also anticipated for 2012, particularly as relates to willingness to participate in the programs and the actual transformative outcomes that might be realized.

6. As these programs represent new engagements with the market, Enbridge recognizes that close attention to market response will be required. Inherent in this will be the need to adapt or fine tune the program designs based on feedback from the market. For all the programs, Enbridge will re-visit the proposed trajectories as part of both the annual evaluation activity and on-going operational reviews and make adjustments as required.

7. Table 1 presents the proposed Program Costs for each Market Transformation program. Program Costs include direct costs which refer to incentives and indirect costs which relate to expenses such as program development, start-up, and promotion. Program evaluation costs are presented in Exhibit B, Tab 1, Schedule 5.

Table 1. Market Transformation Program 2012 Budget

Market Transformation Program	Direct Costs	Indirect Costs	Total Program Costs
DWHR	$1,600,000	$350,000	$1,950,000
SBD Residential	$165,000	$730,000	$895,000
Home Labelling		$300,000	$300,000
SBD Commercial	$220,000	$555,000	$775,000
Total Market Transformation	**$1,985,000**	**$1,935,000**	**$3,920,000**

8. The following pages provide descriptions for the Market Transformation Programs.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

Market Transformation: Drain Water Heat Recovery Program

Program Name: Drain Water Heat Recovery Program ("DWHR")

Goal: Achieve widespread installation of DWHR in residential new construction low rise homes in the Enbridge Gas Distribution Inc. (the "Company" or "Enbridge") franchise territory. The DWHR program will be positioned as a door opener for the Company's new Integrated Design Process ("IDP") initiative being launched in 2012. It is expected that some of the builder participants in the DWHR program will also be interested in the IDP program.

Target Market: Builders of new, residential, low rise (towns, semis, and detached homes) homes in the Enbridge franchise territory. Enbridge will be targeting its promotional activity directly to the builder market. The ultimate target market is residential Rate 1 customers, purchasers of new homes.

End Uses Addressed: Water heating

Background: DWHR saves water heating energy by capturing the waste heat from drain water and using it to pre-heat inlet water. Enbridge's DWHR program focuses on encouraging builders to install the measure during construction of a new home. To date, Enbridge has worked closely with a number of builders, providing installation training and installation in model homes. This initiative has allowed Enbridge to build new relationships with the builder market which can be leveraged as part of the IDP initiative roll-out.

With changes to the Ontario Building Code ("OBC") in 2012, builders have an option to choose either a performance path or a prescriptive path to achieve compliance, where the performance path is achieved through a combination of measures. The DWHR brings the opportunity for builders to meet the energy portion of the OBC requirements by installing the unit in conjunction with one or more other measures offered in a series of prescriptive "packages" under the new OBC.[1] By the end of the Code cycle in 2017, it is anticipated that the installation of DWHR will surpass 50% of all new homes in the market, allowing the measure to be specifically included in the new OBC (i.e., mandatory, subject to the Code adoption process).

As a result of Enbridge's activities to date, participating builders are now installing the measure in all of their new homes. The intent of the program is to amplify that outcome to the rest of the builder market and thus demonstrate that the practicality of including the measure as part of the next OBC. The ultimate success of the initiative is highly dependent upon the builder relationship and builder enrollment is critical to achieving those installations.

Barriers: The primary barrier relates to a lack of awareness among builders about the potential savings and the relative ease of installation. Other barriers include:

- Trades contractors are not willing to install the units;
- Builders are reluctant to change traditional practices; and
- Energy efficiency technologies and related activities compete with other construction priorities.

[1] Note that DWHR measure alone will not be sufficient to achieve OBC compliance.

Strategy: The following table presents a summary of the proposed strategy and tactics for the program. These are further described in the Program Design section below.

Strategy - DWHR	Program Elements - DWHR
Introduce technology to builders and demonstrate energy savings that are achievable	Recruit builders, Enroll them in the DWHR initiative
Demonstrate ease of installation	Support for training and demonstration activities including site installation and model home installation
Encourage rapid market uptake	Provide DWHR units at no cost to participating builders

Program Design: Enbridge support is generally focused on achieving a rapid uptake in the market with a commensurate exit plan as transformation occurs. The program has three main components:

- Introduction of the technology and demonstration of its benefits to builders resulting in builder sign-on and commitment to install the units;
- Training and related demonstration activities intended to demonstrate ease of installation, including specific site installations and support for trainers to engage the new construction market; and
- Provision of the DWHR units at no cost to participating builders.

The marketing of the program will leverage Enbridge's existing relationships with new home builders and will also seek to marry this initiative to the IDP initiative. The table provided on the following page illustrates the various program elements.

Table 1: Drain Water Program Summary

Eligible Measures	Incentives	Technical Assistance	Training / Education	Marketing / Communication	Delivery Channels
Drain Water Heat Recovery	Free to builders (approx $400)	Installation in model homes	installation	Promotion directly to builders	Enbridge marketing, channel Consulants, RenewAbilty, and EcoInnovation

Timeline and Trajectory: The program will be operated in 2012, and sunset in 2015. The incentive amount payable to builders will decrease starting in 2013. In 2012, Enbridge projects 4,000 units will be installed as a direct result of the initiative. In subsequent years, participation will continue to increase ranging from 5,000 units to 6,000 units per year, even as the incentive is decreased to 25% of product cost by 2014. Enbridge envisions ultimately exiting the market in 2015 as builders continue to adopt DWHR and the technology is eventually included as part of OBC compliance.

2012 Program Metrics:

	Weight	2012		
		Lower Band	100%	Upper Band
DWHR units	60%	3,000	4,000	5,000

The number of units installed across all builders in the franchise is the key metric for the initiative.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

2012 Performance Incentive Structure:

The maximum Shareholder incentive is $711,358 for achievement of the upper band of 150% of the scorecard metric. The incentive amount is to be pro-rated for achievement levels between the lower band, 100 % and the upper band.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

Market Transformation: Savings by Design Residential New Construction Program

Program Name: Savings By Design ("SBD"): Residential Program

Goal: Use the Integrated Design Process ("IDP") to demonstrate to builders the potential for achieving higher levels of energy and environmental performance through the application of alternative design approaches. Support this demonstration/awareness with performance incentives that encourage builders to build new homes that are 25% better than existing building Ontario Building Code ("OBC") homes, ultimately leading to the adoption of higher energy efficiency levels in the OBC.

Target market: Larger builders and designers of new, Part 9 residential low rise houses (towns, semis and detached homes) in the Enbridge Gas Distribution Inc. (the "Company" or "Enbridge") franchise territory. The intent is to engage builders who construct multiple homes in any given year (ideally at least 25 homes per year) and Enbridge will be targeting much of its promotional activity directly to the builder market. For 2012, Enbridge is estimating approximately 25,000 new homes will be built in the franchise with the largest 50 builders building the majority of those. The ultimate target market is purchasers of new homes, residential Rate 1 customers.

End Uses Addressed: Heating, ventilation and air conditioning, water heating, other.

Background:

OBC*:* Commencing January 1, 2012, the OBC will implement a requirement for new houses to be designed and constructed to achieve a performance level equivalent to EnerGuide 80. At the same time, Natural Resources Canada ("NRCan") is proposing to move from EnerGuide for New Houses to a new system, similar to the Home Energy Rating System ("HERS") used in the U.S. that will use an energy intensity metric, expected to be GJ/m^2. Both systems will be active in the Ontario marketplace during the next five year OBC cycle.

IDP: The IDP is an approach to design that seeks to create more comprehensive, robust and environmentally sustainable designs for buildings. It is a method for realizing higher performance buildings where energy efficiency and sustainability are maximized without sacrificing any of the services or creature comforts. The process involves the engagement of the important design elements of a building at the outset – as part of the initial design. It uses an iterative approach whereby the design team examines a range of alternatives aimed at finding an optimal mix of technologies such that environmental performance is maximized. It includes the use of detailed energy modelling to estimate the potential energy savings. It also includes the use of technical experts who bring a deep understanding of the interaction of the various technologies that are intrinsic in the home's ultimate energy use and environmental performance.

The IDP has been used sparingly for Part 3 commercial building design but it has proven to be a critical mechanism for achieving greater environmental performance, including energy efficiency. This program aims to take those IDP principles and apply them to the design of Part 9 residential buildings.

The outcome of a successful application of the IDP is the realization of higher energy performance through a combination of improved sizing and design to, (for example), optimize passive solar, integrate mechanical systems into a high efficiency multi-purpose system, reduce and/or optimize appliance loads, and improve the thermal characteristics of the envelope. Important co-benefits are the correct sizing of the furnace and ventilation systems and reduced customer complaints related to drafts and variable indoor air temperatures. Note as well that the intent of the process is to lower energy use regardless of fuel type. As such, both natural gas and electricity savings are expected as an outcome.

Barriers: As indicated, the IDP has experienced some use in the commercial buildings sector(s). It is rarely, if ever, used in the residential new construction sector. Encouraging residential builders to step away from the traditional design paradigm and use a more holistic approach to new construction represents a significant change in process. Most builders do not have on-staff architects and rely on designs that are contracted to third party design firms who do the drawings while considering the architectural features and building size. They typically use a standardized specification based on the OBC. The selection of the Heating, Ventilation, and Air Conditioning (“HVAC”) and related systems is done after that design by the HVAC contractor. These contractors rely on tried and true systems with no consideration of any of the design elements. Conversely, designers rarely incorporate any consideration of heat loss, system efficiency or related energy performance as part of their design activities. This disconnect in design related activities represents both the barrier and the opportunity for a new program.

Further, a builder may employ multiple designs in a sub-division – all of which have similar inherent design processes. As such, builders are often reluctant to consider new approaches – particularly if there are concerns about additional costs or time to receive an approval. Long-term energy performance beyond the requirements of the OBC is thus not a consideration for many builders. It is critical that builders be shown ways to achieve higher energy performance that can be applied to all their various designs.

Strategy: The following table presents a summary of the proposed strategy and tactics the program will use. These are further described in the Program Design section below.

Strategy - IDP	Program Elements - IDP
Introduce concept to builders and demonstrate the potential improvements and energy savings that are achievable	Recruit builders, Enroll them in the IDP workshops
Work to ensure industry has the capability to deliver IDP and the requisite energy modelling	Support for sector associations who train energy raters, IDP professionals, etc.
Encourage builders to apply what they have learned to an actual new build	Provide incentive for homes achieving greater than 25% above OBC efficiency
Support the consideration of higher energy efficiency requirements as part of OBC development	Monitor OBC development and ensure that OBC officials are aware of the market activities that might support a higher OBC

Program Design: Enbridge support will, in part, be directed towards encouraging new design paradigms that can offer significant energy efficiency gains versus more conventional approaches. The program will have three main components as noted below.

- Financial support for integrated design activities – Note: these must adhere to an Enbridge approved IDP process such as IEA Task 23 or the iiSBE developed IDP Tool and also include the requisite energy model such as HOT2000).

- Infrastructure support – This includes outreach and support of key delivery agents for training and/or capability building for facilitators, energy raters and modeler.
- Financial incentives for homes that achieve 25%[2] or greater than OBC efficiency based upon the requisite modelling effort - this incentive is anticipated to engage the market starting in 2013. However, Enbridge will allow access to the incentive for those builders that complete construction in 2012, provided they have completed the IDP process. An incentive of $2,000 per home is available for homes that achieve the 25% or greater level.

The marketing of the program will leverage both the EnergyStar network that Enbridge has supported in the past and the builders currently participating in the Drain Water Heat Recovery ("DWHR") and Energy Savings Kit initiative ("ESK"). The larger of these builders will be encouraged to consider undertaking an IDP through the new initiative and be shown the potential energy reductions benefits that are available above and beyond prescriptive measures.

Other important features of the program include the following.

- Participating builders will agree to enroll in the program for a three year period and will commit to undertaking at least one IDP during this time, adhering to an Enbridge approved IDP process as described above. This

[2] Equivalent to an EnerGuide Rating of 84

is intended to demonstrate how to achieve at least 25% total energy savings relative to the OBC.

- Enbridge will also provide performance incentives to builders who are enrolled in the initiative for units constructed to the increased level of performance during the commitment period. Note that builders must complete the IDP to be eligible for the follow-on building incentive. Participating builders will be expected to construct units at the higher level of efficiency as part of the Memorandum of Understanding ("MOU").
- Enbridge will establish an oversight committee including Enbridge's new construction team and key experts who would be responsible for establishing the mandatory content of the IDP and ensuring that tools and models used as part of the process are appropriate.
- As part of enrollment, participants may be requested to allow Enbridge to feature their project in marketing and outreach materials and to use the project as part of a demonstration effort. Finally, participating builders may be asked to sit on a best practices committee that will assist in the delivery of the initiatives(s) within Enbridge's franchise.
- As part of an overarching sector strategy, Enbridge's new construction team will engage senior management decision-makers who will ultimately lead the drive to build above OBC levels. This includes Enbridge assistance with marketing efforts intended to ensure a consistent message regarding the benefits of an energy efficient home.

This program primarily focuses on the design features of new homes that ultimately impact the energy use. Through the application of integrated design activities, builders will be encouraged to achieve greater levels of energy performance. The ultimate end-point for this kind of strategy would be a majority of new homes conforming to an efficiency rating 25% above OBC. It is noted however that other factors are influencing the market, including potential interest in “Net Zero” Homes, “PassivHaus” homes, “Solar-ready” homes, and other variations of low-energy homes. The program design needs to be flexible enough to adapt to or accommodate these kinds of trends and Enbridge staff will actively monitor activities and trends that might impact the program design or operation.

The table below provides a summary of the program elements: eligible measures, incentives, technical assistance, training and education, marketing, and delivery channels.

<u>Table 1: Savings by Design Residential Program Summary</u>

Eligible Measures	**Incentives**	**Technical Assistance**	**Training / Education**	**Marketing / Communication**	**Delivery Channels**
Thermal envelope improvements, highest efficiency gas furnaces and boilers, high efficiency water heating, low water flow devices, HRVs, drain water heat recovery, other measures identified through the energy modelling	Fixed incentive of $15,000 per builder for IDP Incentive: $2,000/home for OBC - 25%	Installation for specific measures as required	IDP and energy modelling training	Promotion directly to builders, energy raters and modelers	Enbridge marketing, energy raters and modelers, and applicable associations and business partners

<u>Timeline and Trajectory:</u> The program will be launched in 2012, and is expected to continue for at least five years, depending upon market response.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

The program will focus on engaging builders in the principles of IDP throughout its projected time horizon, but will also include a performance incentive intended to encourage energy savings through the application of the principles learned through the IDP portion of the program. By the second year, it is anticipated that some of the builders will begin to construct homes to standards above the OBC and take advantage of the performance incentive.

In later years, the IDP portion of the program will begin to ramp down while the energy performance part of the program ramps up as builders move from the learning phase to implementation and begin to take advantage of the gas savings incentive. Throughout the continuum of the program, Enbridge will monitor the effectiveness of the proposed offerings and adjust the design as required. Depending upon uptake, this may require an adjustment to the proposed incentives.[3]

In 2012, Enbridge expects 11 builders to undertake the IDP consistent with the initiative design requirements. In subsequent years, 20 to 30 builder participants per year in the IDP portion are anticipated. By 2013, participating builders will begin to build homes at 25% better than OBC, gaining access to Enbridge's $2,000 per home incentive. Enbridge expects that by 2017, approximately 3,000 to 5,000 homes in the province will have been built to the OBC – 25% level.

By the end of the program, it is expected that enough builders (approximately 50 builders, representing 50% of the largest builders) will have demonstrated that

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[3] Note that Enbridge may need to establish a cap on incentives as participation in the program increases.

they can build to 25% better than OBC. At that point, it is expected that OBC officials can recognize that a rating of 25% better than OBC is achievable and consider this as part of ongoing OBC development. As noted, Enbridge also expects that approximately 3,000 to 5,000 homes will have been built to the OBC – 25% level. While a greater number of homes built to the higher level is clearly desirable, the focus of the program and key measurement for success in the short term is the number of builders who have demonstrated that they can achieve the 25% above Code level.

Enbridge will also closely monitor the results of the initiative to determine if and when builders are capable of surpassing the OBC-25% level. If this is found to be the case, this information will be provided to OBC officials as appropriate. There may be opportunities to advance OBC development such that an even higher rating (i.e; greater than 25% better than current levels) is considered by OBC officials for the next OBC cycle. This would represent a significant achievement in the market.

2012 Program Metrics:

	Weight	2012		
IDP		Lower Band	100%	Upper Band
Top 20 Builders Enrolled	20%	1	2	3
Top 80 Builders Enrolled	20%	7	9	18

Builders Completing IDP:

The number of builders who undertake an integrated design process for a project will be tracked and reported. The intent is to have builders realize the potential of alternative designs and then apply those designs in a manner that saves energy and allows them access to further financial incentives from Enbridge.

As well, since the greatest impact of any transformation that occurs will be from larger "tract" builders, the proposed metric reflects the need to achieve participation from the largest builders. The proposed metric gives an equal weighting to the 2 metrics.

2012 Performance Incentive Structure:
The maximum Shareholder incentive is $474,239 for achievement of the upper band of 150% of the scorecard metric. The incentive amount is to be pro-rated for achievement levels between the lower band, 100% and the upper band. As noted there is an equal weighting for each metric.

Market Transformation: Home Labelling Program

Program Name: Home Labelling Program

Goal: Achieve widespread adoption of a voluntary home labelling system in the residential home resale marketplace. The new initiative will be modelled after an existing energy rating platform such as that currently used by the Eco-Energy Audit program.

Target market: The immediate target market to enable the deployment of a home labelling system is realtors and their various real estate boards. The target market for use of such a system and subsequent influence on retrofit activity are sellers and purchasers of existing homes and the home inspection and renovation contractor markets. The ultimate target market is purchasers and owners of existing homes, residential Rate 1 customers.

End Uses Addressed: Heating, ventilation and air conditioning, water heating, other.

Background: In the early 1980's, home inspections as a condition of offer were a rare occurrence in Ontario. Information gathered from The Toronto Real Estate Board likens the home labelling initiative to the home inspection market. Through aggressive marketing by the home inspection industry, by 1985 home inspection as a condition of offer was common place. Today, virtually all potential home sales include a home inspection as a condition. This is the kind of market transformation that would be the ideal outcome for a home labelling initiative.

Energy rating and subsequent home labelling would most often occur at or near the time of sale. Buyers in particular would be interested in knowing the energy rating of the home while sellers of homes that have a high rating may experience a price premium for their homes. Those whose homes have a lower rating might consider retrofit activities designed to increase the rating. From either the seller's or the buyer's perspective, there is a potential opportunity to influence the nature of the various retrofit activities that occur in a home given that considerable renovation activity occurs just prior or within eighteen months after the sale of a home.

The home labelling initiative is designed to take advantage of this window of opportunity by introducing home labelling into the residential resale marketplace. This activity encompasses the notion that "you can't manage what you don't measure" and marries the concept to a communication platform available through the Multiple Listing Services ("MLS") or similar listing of homes for sale. By encouraging the listing of the energy rating on the MLS, a "value" for energy performance is assigned to the home. Homes that have a higher rating will see a higher market value than homes with a lower score. This will help to encourage homeowners to consider energy efficiency as part of their renovation expenditures.

With the available information, potential home buyers would also be able to ask what the energy rating is and if no assessment has been made, they could make their offer subject to assessment, just as offers are made subject to a home inspection. This further engenders the use of the system.

The mandatory introduction of a similar home labelling system was proposed as part of the Green Energy and Green Economy Act but this provision was subsequently removed after opposition from the real estate industry which argued that the mandatory application of energy rating would delay the transaction. For this reason, Enbridge Gas Distribution Inc. (the "Company" or "Enbridge") believes that a voluntary system designed to gain traction in the market using existing infrastructure is an appropriate approach. The objective of the initiative is to achieve voluntary adoption of a home labelling system such that it becomes standard practice in the resale home market – similar to the home inspection experience.

Barriers: As noted, the real estate industry was not supportive of mandatory home labelling as part of the Green Energy and Green Economy Act. The industry's perspective was that the requirement would add delays to the transaction. This opposition remains a key barrier that must be addressed through the program design. Other important barriers include:

- Cost of the audit to identify the energy rating for the home;
- Perceived costs for related follow-on retrofit activities and lack of understanding of the impact of energy retrofits on utility bills and of the home's untapped potential for energy savings; and
- Lack of understanding of an energy rating – what does it mean and the associated benefits of providing the energy rating at time of sale.

Strategy: The following table presents a summary of the proposed strategy and tactics the program will use. These are further described in the Program Design section provided on the following page..

Strategy - Home Labelling	Program Elements - Home Labelling
Introduce concept to the real estate industry. Focus on realtors who are pre-disposed and use them to help with subsequent marketing	Recruit realtors and determine willingness to assist – tailor messaging to their needs
Establish home labelling fields on MLS services	Reach out to major listing services in the franchise. Identify potential barriers
Create awareness of the benefits of home labelling	Communications campaign focusing on the benefits. Target homeowners, and real estate industry
Develop and/or amplify the existing home labelling infrastructure	Provide financial and other support to expand the capacity in the market to deliver home labelling

Program Design: Enbridge support is initially focused on establishing the necessary conditions for eventual market adoption. This represents a two-pronged approach aimed at creating the demand for home labelling while also building the market's capability to deliver the ratings.

Through a variety of communication campaigns, including outreach and direct marketing to select realtors and more broad scale communications to homeowners, the initial goal will be to influence attitudes and perception of homeowners and the real estate community to the benefits of a home labelling system for resale homes. These activities may also encompass workshops or similar knowledge focused events. Concurrently, communications will be developed that target municipalities and financial institutions to ensure that they also understand the benefits.

The initiative will seek to engage the “supply side” of the industry by supporting capability building efforts for home energy raters, home inspection companies and home appraisers. Ultimately, home labelling assessments are expected to be undertaken by independent energy raters as qualified through the Eco Energy Retrofit program and/or by home inspection companies who also have the necessary energy rating qualifications. Organizations that already deliver these services can be leveraged to assist with the communications effort by encouraging their prospective clients to “post” their energy rating if they are selling their home.

Enbridge contends that a number of other organizations, including the provincial government, other utilities, financial institutions and municipalities, will likely have an interest in supporting this initiative. Enbridge will seek to engage commitment from these stakeholders as part the outreach strategy.

The table on the following page provides a summary of the program elements: eligible measures, incentives, technical assistance, training and education, marketing, and delivery channels.

Table 1: Home Labelling Program Summary

Eligible Measures	Incentives	Technical Assistance	Training / Education	Marketing / Communication	Delivery Channels
N/A	May consider an incentive to the "pioneer" realtors who first sign on – budget may restrict this as a viable option	Develop-ment of means for realtors to include rating in MLS.	Training / education for realtors, energy raters, and home inspection firms, etc as well as the existing residential customers	Promotion to realtors, energy raters, home inspection firms, and existing residential customers	Enbridge marketing, energy rates and modelers, and applicable associations and business partners

Timeline and Trajectory: The program will be launched in 2012 and is expected to continue for approximately five years, depending upon market response. An exit strategy consistent with a significant uptake in the market will be developed as warranted. Enbridge estimates that uptake above 25% would represent an appropriate threshold for a program exit. However, any decisions regarding an exit strategy will be made as part of an evaluation of the transformative aspects of the initiative.

In 2012, activities focus on securing endorsement of the concept from realtors and commitments for participation, market research and analysis to support design and development for implementation in 2013, and outreach/coordination with the home labelling supply channel. The market research will also provide guidance on estimated time for new concepts to penetrate the resale home market. It is expected that some of the "early adopter" realtors will begin to rate (some of) their homes and provide the rating result to interested potential buyers (including using the rating field on the MLS). Outreach to other potential stakeholders will also be undertaken with the intent of gaining support for the concept.

In 2013, intensive marketing and promotion to home buyers and additional realtors commences, including training and related support activities will result in growing awareness in the industry. This will result in uptake in the market beyond just the early adopters and Enbridge hopes to see approximately 250 to 500 homes rated and reported using the rating field. 2014 to 2015 sees continued program promotion, with a focus on encouraging all potential buyers to request the label. Resulting increases in uptake are expected in the range of 500 to 2,000 homes per year.

2012 Program Metrics:

Weight	2012		
	Lower Band	100%	Upper Band
7%	N/A	Commitment from realtors collectively responsible for more than 5,000 home listings/year	Commitment from realtors collectively responsible for more than 10,000 home listings/year.

2012 PERFORMANCE Incentive Structure:

The maximum Shareholder incentive is $125,173 for achievement of the upper band of 150% of the scorecard metric. The incentive amount is to be pro-rated for achievement levels between the lower band, 100% and the upper band.

Market Transformation: Savings By Design Commercial New Construction Program

Program Name: Savings By Design ("SBD"): Commercial Program

Goal: Use the Integrated Design Process ("IDP") to demonstrate to builders the potential for achieving higher levels of energy and environmental performance through the application of alternative design approaches. Support this demonstration/awareness with incentives that encourage builders to use the knowledge gained in the IDP to design and build buildings that are more energy efficient than the current Ontari Building Code ("OBC") buildings, ultimately leading to the adoption of higher energy efficiency levels in the OBC.

Target market: Builders and designers of new, Part 3 commercial buildings in the Enbridge Gas Distribution Inc. (the "Company" or "Enbridge") franchise territory, Rate 6 customers. Enbridge will be targeting its promotional activity to owners, builders and developers, design teams including architects and design engineers, and energy modelers.

End Uses Addressed: Heating, ventilation and air conditioning, water heating, other.

Background:
Enbridge has been offering the Design Assistance Program ("DAP") since 1999. That program has successfully engaged the new building design community – particularly as relates to the use of energy modelling as a way of demonstrating the potential energy savings through the application of new technologies and design principles.

The IDP has proven to be a critical mechanism for achieving greater environmental performance, including energy efficiency. The DAP initiative provides assistance with energy modelling and encourages the use of the IDP as a core principle of the program design. However, while a critical component of IDP, energy modeling is only one step in the IDP process.

This proposed new program represents an evolution of the DAP program wherein participating design teams are now expected to provide a more complete IDP experience for their respective projects. Proponents must adhere to the IDP principles as specified by internationally recognized processes and must provide a final report that reflects that undertaking. Energy modeling is a critical (but not the only) component of that process. The intent is to achieve higher energy performance through a combination of improved sizing and design to optimize passive solar, day lighting, and natural ventilation; high efficiency lighting, as well as heating, ventilation, and air conditioning ("HVAC") systems; the integration of lighting and HVAC controls to respond directly to occupant loads; reducing and/or optimizing internal loads; and improving the thermal characteristics of the envelope.

OBC: Commencing January 1, 2012, the OBC will implement a requirement for all buildings to be designed to exceed by not less than 25%, the energy efficiency levels attained by conforming to the Model National Energy Code for Buildings ("MNECB") as defined in Supplementary Guideline SB-10. This may be confirmed by either following the MNECB and exceeding it by the stated amount, following ASHRAE 90.1-2010 as published and exceeding it by 5%, or by following the ASHRAE 90.1-2010 Ontario Hybrid as described in SB-10. It is anticipated that when the MNECB is published by the Canadian Codes Centre, the OBC will also be added as an option in a revised version of SB-10.

IDP: The IDP is an approach to design that seeks to create more comprehensive, robust and environmentally sustainable designs for buildings. It is a method for realizing higher performance buildings where energy efficiency and sustainability are maximized without sacrificing any of the services or creature comforts. The process involves the engagement of the important design elements of a building at the outset, as part of the initial design. It uses an iterative approach whereby designers work together to find an optimal mix of technologies such that environmental performance is maximized. It includes the use of detailed energy modeling and building rating systems to estimate the potential energy savings. It also includes the use of technical experts who bring a deep understanding of the interaction of the various technologies that are intrinsic in the building's ultimate energy use and environmental performance.

When the IDP has been used, it has proven to be a critical mechanism for achieving greater environmental performance, including energy efficiency. The outcome of a successful application of the IDP is the realization of higher energy performance through a combination of improved sizing and design to, (for example), optimize passive solar, integrate mechanical systems into a high efficiency multi-purpose system, reduce and/or optimize appliance loads, and improve the thermal characteristics of the envelope. Important co-benefits are the correct sizing of the mechanical systems and the potential to save capital investment expenditures by specifying smaller equipment. Note as well that the intent of the process is to lower energy use regardless of fuel type. As such, both natural gas and electricity savings are expected as an outcome.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

Barriers: The IDP has made some penetration into the commercial buildings sector(s), however its use still represents the minority of projects. Encouraging designers to step away from the traditional design paradigm and use a more holistic approach to new construction represents a significant change in process. There is also an optic that engaging in integrated design adds time and cost to the design phase. Builders/developers often adhere to the "time is money" adage and are reluctant to undertake activities that might impact timelines. As well, many do not end up owning and operating the buildings. As such, they may not be interested in improvements to building characteristics that are intended to save energy – particularly if they believe the energy savings come at an increased cost.

Strategy: The table on the following page presents a summary of the proposed strategy and tactics the program will use. These are further described in the Program Design section on the following page.

Strategy - IDP	Program Elements - IDP
Introduce concept to builders/developers and demonstrate the potential building improvements and energy savings that are achievable	Recruit builders/developers, Enroll them in the IDP workshops
Ensure adequate number of design professionals who can deliver the IDP	Support for training of design professionals, sector associations, etc.
Encourage builders/developers to apply what they have learned to an actual new build	Provide performance based incentive for buildings achieving natural gas savings associated with above OBC efficiency levels
Verify savings to ensure buildings are achieving energy savings	Provide commissioning incentives for buildings undertaking prescribed commissioning activities
With sufficient market share of both builders and homes, impact the new building OBC	Engage OBC officials and ensure that they are aware of the market activities that might support a higher OBC

Program Design: Enbridge support will be, in part, directed towards encouraging new design paradigms that can offer significant energy efficiency gains versus more conventional approaches. The program will have four main components:

- Financial support for integrated design activities - Note: these must adhere to an Enbridge approved IDP process such as IEA Task 23 or the iiSBE developed IDP Tool.
- Infrastructure support – This includes training and capability building for facilitators and energy modelers, who would be key delivery agents for the integrated design activities. Based on the need, Enbridge may also consider supporting training efforts related to building commissioning.
- Financial incentives – These are based on a $0.20/m^3 index for buildings that exceed OBC efficiency levels by defined hurdle rates using the requisite modelling effort (“performance incentive”). The incentive will be

provided in two stages: 50% once construction has commenced and 50% once the building is commissioned.

- Commissioning incentive – This is the lesser of 20% of the performance incentive, or $5,000.

The marketing of the program will leverage both the existing DAP network and the various sector associations in the market. Other important features of the program include the following.

- Participating builders will agree to enroll in the program for a 3 year period during which time they will commit to undertaking at least one IDP adhering to an Enbridge approved IDP process as described above. This is intended to demonstrate how to achieve at least 25% total energy savings relative to the OBC.
- Enbridge will also provide performance incentives to Builders who are enrolled in the initiative for units constructed to the increased level of performance during the commitment period. Participating builders will be expected to construct units at the higher level of efficiency as part of the Memorandum of Understanding ("MOU").
- Enbridge will establish an oversight committee including Enbridge's new construction team and key experts who would be responsible for establishing the mandatory content of the IDP and ensuring that tools and models used as part of the process are appropriate;
- As part of enrollment, participants may be requested to allow Enbridge to feature their project in marketing and outreach materials and to use the project as part of a demonstration effort. Finally, participating builders may be asked to sit on a best practices committee that will assist in the delivery of the initiatives(s) within Enbridge's franchise.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

- As part of an overarching sector strategy, Enbridge's new construction team will engage senior management decision-makers who will ultimately lead the drive to build above OBC levels. This includes Enbridge assistance with marketing efforts intended to ensure a consistent message regarding the benefits of an energy efficient building.

The table below provides a summary of the program elements: eligible measures, incentives, technical assistance, training and education, marketing, and delivery channels.

Table 1: Savings by Design Commercial Program Summary

Eligible Measures	Incentives	Technical Assistance	Training / Education	Marketing / Communication	Delivery Channels
Thermal envelope improvements, highest efficiency gas furnaces and boilers, high efficiency water heating, low water flow devices, HRVs, drain water heat recovery, earth-tube ventilation air pre-conditioning, natural ventilation, optimizing natural light other measures identified through the modelling	Fixed incentive of \$15,000 per design team for IDP. Incentive: $\$0.20/m^3$ for all savings as compared to OBC (up to a max of \$50,000.) Commissioning incentive of the lesser of 20% of performance incentive or \$5,000.	n/a	IDP facilitation Building commissioning training.	Promotion directly to builders/ developers, design teams, architects, design engineers and energy modelers	Enbridge marketing, design teams, architects and design engineers, energy modelers and applicable associations and business partners

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

Timeline and Trajectory: The program will be launched in 2012, and is expected to continue for at least five years, depending upon market response.

The program will focus on engaging builders in the principles of IDP throughout its projected time horizon, but will also include a performance incentive intended to encourage energy savings through the application of the principles learned through the IDP portion of the program. By the second year, it is anticipated that some of the builders will begin to construct buildings to standards above the OBC and take advantage of the performance incentive. Throughout the continuum of the program, Enbridge will monitor the effectiveness of the proposed offerings and adjust the design as required. Depending upon uptake, this may require an adjustment to the proposed incentives.[4]

Starting in 2013, the success of the program will also be measured by the amount of natural gas saved as a result of projects that apply for follow-on financial incentives using the performance incentive metric. The focus of the IDP is to demonstrate that significant savings versus the OBC are possible through the application of the IDP. The performance part of the program pays those builders for achieving those natural gas savings (based upon modelled results). In 2013, Enbridge anticipates approximately ten projects will achieve the required efficiency levels versus the new OBC levels. For 2014 and beyond, Enbridge expects approximately 15 to 30 projects per year will achieve the required efficiency levels.

[4] Note that Enbridge may need to establish a cap on incentives as participation in the program increases.

The commissioning incentive will be provided to authorized commissioning agents who successfully complete a building commissioning study on a new building that has participated in this program or previous versions of Enbridge commercial new construction program(s). Commissioning activities are expected to start occurring in 2012 and continue throughout the program. Enbridge anticipates that most of the buildings that receive the performance incentive will also receive the commissioning incentive. Enbridge will also make the commissioning incentive available to previous users of the DAP program. Enbridge expects 20 commissioned buildings in 2012 and 20 to 30 commissioned buildings in subsequent years.

By the end of the program, it is expected that enough builder/developers (approximately 50, representing 25% of the largest) will have demonstrated that they can design/build to 25% better than OBC. At that point, it is expected that Code officials can recognize that a rating of 25% better than OBC is achievable and consider this as part of ongoing OBC development.

Enbridge will monitor the OBC development process and report the results of the program to OBC officials as appropriate. There may be opportunities to advance OBC development such that an even higher rating is considered by OBC officials for the next cycle. This would represent a significant achievement in the market.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

2012 Program Metrics:

	Weight	**2012**		
		Lower Band	**100%**	**Upper Band**
IDP - Builders / Developers (Design Teams) Completing IDP	20%	6	8	15

Design Teams Completing IDP:

The number of design teams who undertake an integrated design process for a project will be tracked and reported. The intent is to have builders, developers and designers realize the potential of alternative designs and then apply those designs in a manner that saves energy and allows them access to further financial incentives from Enbridge. Enbridge expects to engage eight builders/projects in the IDP in 2012.

2012 Performance Incentive Structure:

The maximum Shareholder incentive is $323,365 for achievement of 150 % of scorecard metrics. The incentive amount is to be pro-rated for achievement levels between the lower band, 100% and the upper band.

EVALUATION PLANS

Introduction

1. Parallel with program delivery, Enbridge Gas Distribution Inc. ("Enbridge" or the 'Company") has been actively engaged in monitoring and evaluating its Demand Side Management ("DSM") program results for over 15 years. The Company has developed advanced monitoring and tracking systems to record results of current programs and conducts annual verification studies on selected programs. In a recent DSM audit, the auditor found that several of the Company's program processes, data tracking, and oversight activities reflect industry best practices.[1]

2. On an as needed basis, the Company also conducts evaluation studies to update the assumptions that underpin the calculation of program results and reviews program operation with a view to improving program delivery. Under the current DSM Framework evaluation work has been conducted in consultation with the Evaluation Audit Committee ("EAC"). This section presents the Company's Evaluation plans for its DSM programs for the plan period 2012 to 2014.

3. Through experience and through on-going dialogue with DSM auditors, the EAC and Intervenors, the Company has developed a policy and approach that guides development of evaluation plans and proposed evaluation activities for individual programs and initiatives. Factors that determine the nature of the evaluation activities include:
    - whether the program is delivered by Enbridge or a third party;
    - the size of the program in relation to the overall DSM portfolio;
    - whether the program has had previous evaluations and the relevance of those evaluation results in light of the current program;

[1]Cadmus Group Inc., Independent Audit of 2009 DSM Program Results, June, 2010, page 4.

- whether the program uses a custom or a prescriptive approach for delivery; and
- the intent of the program – resource acquisition or market transformation.

Results of Current Programs

4. The following table presents the Company's general approach to evaluation of the results from current programs, distinguishing between activities where Enbridge is the delivery agent and activities where there is an external delivery agent.

Results of Current Programs

	Enbridge Is The Delivery Agent	External Delivery Agent
Monitoring and Tracking	Internal tracking system includes checks to ensure that the customer has not already participated	Enbridge receives tracking report from delivery agent and checks against database to ensure that the customers recorded have not already participated
Verification of install	For larger custom projects, Enbridge staff visit the site to verify installation	Enbridge conducts a third party study to verify that the devices were installed as reported by the delivery agent
Verification of retention for devices that can be easily removed ("persistence")	Enbridge conducts a third party study to verify that the devices are still in place.	Enbridge conducts a third party study to verify that the devices are still in place.
Engineering Review of Custom Projects	Enbridge conducts a third party engineering review of the savings calculations for a sample of large custom projects. The results are applied to the total population of custom projects in that year. For example, if the review finds that the results for the sample of projects were overstated by 5%, the results of all custom projects are reduced by 5%.	

Future Results

5. For some programs, the energy savings results are based on engineering estimates of savings. These are commonly called “deemed” or “prescriptive” savings and programs. For these programs, engineering studies are used to develop estimated savings associated with the installation of a particular device, e.g., a low flow showerhead. The resulting savings estimates are applied to every unit installed. For prescriptive programs there is a need to review the research underlying the deemed savings and to update the research from time to time.

6. For large custom projects, Enbridge staff or the consulting engineering firm designing the project calculate the estimated savings which may be subsequently verified as part of an evaluation effort. As well, evaluation studies may be carried out to validate the various calculation techniques that are used to estimate the savings.

7. Adjustment factors such as free ridership are used in the utility’s calculation of program results for both prescriptive and custom programs. The adjustment factors are also the results of evaluation research.

8. Recommendations for evaluation studies affecting future program results may originate with Enbridge, the DSM auditor, and, under the current DSM Framework, through the EAC. Recommended studies currently under development include an industrial free ridership study and a study on the calculation of savings for residential weatherization measures.

Direction for DSM Evaluation During the 2012 to2014 Period

a) Stakeholder Engagement

9. Under the current DSM Framework, Enbridge has consulted extensively with the EAC on program verification, evaluation priorities, and evaluation research studies. The evaluation plans presented in this section reflect that dialogue. The Terms of Reference for Stakeholder Engagement in the 2012 to 2014 period presented elsewhere in this submission outline a continuing role for Intervenors in the utility's DSM research and evaluation activities. The proposed Terms of Reference include a common Technical Evaluation Committee for Enbridge and Union Gas Ltd. ("Union") with representation from Intervenors, the utilities and independent members with appropriate technical expertise. A key role for the Technical Evaluation Committee will be to work with the utilities to set evaluation research priorities. One of the first tasks for the Technical Evaluation Committee under the new Framework will be to review and potentially revise or refine the evaluation priorities and plans presented here.

b) Program Evaluation

10. In the 2012 to 2014 period, new programming activities will necessitate new approaches to program evaluation. More emphasis on monitoring and tracking is anticipated as the Company implements program activities such as Run It Right that rely on performance based results rather than on engineering estimates. Program design features such as the cap on spending for particular rate classes will also bring an increased requirement for program tracking. As well, a stronger focus on program theory and logic models will support the increased focus on market transformation and the development of new programs. Finally, evaluation activities will likely focus on updating potentially outdated assumptions (e.g., for commercial and industrial project free ridership), addressing recent audit recommendations and assessing

impacts of new programs and/or existing programs on which greater emphasis will be placed in the next three years.

c) Collaboration with Union

11. For the past several years Enbridge and Union have collaborated extensively on DSM research and evaluation including development and updating of measure assumptions and special evaluation studies. The new Terms of Reference for Stakeholder Engagement support this collaboration through the establishment of a common Technical Evaluation Committee and a common Technical Reference Manual. As a first step in development of the Technical Reference Manual, Union and Enbridge developed a common Table of Measure Assumptions and a common set of Substantiation Documents for submission with their respective 2012 plans. Throughout the plan period Enbridge will continue to look for opportunities to partner with Union in the development and implementation of DSM research and evaluation initiatives.

12. The following pages (pgs 7 to 33) present the Company's Evaluation plans for its DSM programs for the plan period 2012 to 2014. The evaluation plans are linked to the detailed program descriptions of each program which can be found at Exhibit B, Tab 1, Schedule 4. Projected evaluation costs for 2012 by program are shown in the Table provided on the following page.

    - Note: Costs shown are direct costs only; they do not include evaluation related overhead costs such as tracking and reporting, management of research, and associated stakeholder engagement. As noted earlier the evaluation priorities, plans and associated budget presented here will be reviewed with the Technical Evaluation Committee and are subject to change based on evaluation priorities or in changes in program design and delivery during the plan period.

2012 Projected Evaluation Costs		
Resource Acquisition		
	Residential Program	$150,760
	Commercial Program	$212,187
	Industrial Program	$129,187
Low Income Program		$20,000
Market Transformation		
	Drain Water Heat Recovery Program	$5,000
	Savings by Design Residential Program	$7,500
	Home Labelling Program	
	Savings by Design Commercial Program	$7,500
General		$197,965
Total	Audit and other multi-program evaluation	$730,098
Note	Some elements of evaluation for the Low Income program are included in Resource Acquisition	

Evaluation Plan

Community Energy Retrofit Initiative

Residential Resource Acquisition Program

1. Program Description	**Program Description – See Exhibit B, Tab 1, Schedule 4**
2. Evaluation Goals and Objectives	**Program Theory:** The Community Retrofit initiative takes a holistic approach, encompassing natural gas, water and electricity savings measures. The initiative will seek to engage residents through the use of focused educational materials, local specialized events and outreach, storefront or retail engagement and collaboration with local schools in some delivery aspects. The initiative uses the Eco-Energy Audit as its foundation, but provides amplified delivery through the community focus. Enbridge incentive funds will be directed at covering the cost of the initial audit and providing a performance incentive based on natural gas saved as a result of measures installed or activities undertaken as identified by the audit. The neighbourhood focus will encourage high uptake levels and an efficient use of public resources to achieve energy conservation. **Evaluation Goals:** • Provide confidence that results are accurately tracked and reported • Demonstrate the effectiveness of measures and measure assumptions to provide confidence that reported results are based on best available information • Assess the effectiveness of the delivery model in order to enhance initiative effectiveness and participant satisfaction. • Inform long-term DSM program planning **Evaluation Objectives:** • Ensure that appropriate tracking, verification has been completed throughout program year, e.g., verify that reported measures were actually installed and were not later removed. • Conduct internal review of program operation. **Previous and Ongoing Evaluation Studies:** The Community Energy Retrofit initiative is a new offer in 2012, and no previous evaluation studies have been conducted. An evaluation effort focusing on calculation of savings for residential weatherization measures are currently under development will have applicability to this initiative.

Witnesses: A. Mandyam
J. Ramsay

3. Evaluation Elements	This Evaluation Plan document will be subject to change resulting from discussions through the stakeholder engagement process. • Complete research on weatherization savings calculations • Conduct an internal process review to gain understanding on how successfully the initiative was delivered to market, focusing on participant satisfaction, contractor capability and potential recommendations for future community based programming. IMPACT EVALUATION: ☒ Verification PROCESS EVALUATION: ☒ Program Design & Delivery Review
4. Evaluation Approach	The program administrator (Enbridge) is responsible for the evaluation activities listed above including: • Program tracking and reporting • Verification studies • Other evaluation studies Enbridge will consult with intervenors regarding these evaluation activities as provided through the Board approved DSM Stakeholder Terms of Reference.
5. Special Provisions	No special provisions.
6. Data Collection Responsibilities	Monthly data submissions provided to Enbridge by delivery partners. Data includes: • Address of audit / retrofit • Housing type and square Footage • Base Case natural gas consumption • Measures completed at home • Cost by measure and total retrofit cost • Gas savings (m^3) by measure and total gas savings Enbridge Market Development staff will work with delivery agents in order to qualify Enbridge franchise customers who are eligible for this initiative.
7. Evaluation Team	(see table below)

Organization	Name	Title / Accountability
Enbridge	Judith Ramsay	Manager, Research and Evaluation
Enbridge	Corrie Morton	Senior Analyst, Research and Evaluation
Enbridge	Jim Grant	Senior Market Research Analyst
Enbridge	Pam Callow	Program Manager, Market Development
Enbridge	Sharon Moffat	Senior Analyst DSM Reporting

Evaluation Plan

TAPS Initiative

Residential Resource Acquisition Program

<table>
<tr><td>1. Program Description</td><td>Program Description – See Exhibit B, Tab 1, Schedule 4</td></tr>
<tr><td>2. Evaluation Goals and Objectives</td><td>Program Theory:
The TAPS initiative is an energy savings package that targets Rate 1 residential customers with the goal of reducing their gas and water consumption through energy efficiency devices. This initiative offers free energy efficient products that can easily be installed or that will be directly installed by a TAPS Contractor in order to reduce energy costs to Enbridge customers across the franchise.

Evaluation Goals:
• Provide confidence that program results are accurately tracked and reported
• Demonstrate the effectiveness of measures and measure assumptions to provide confidence that reported results are based on best available information

Evaluation Objectives:
• Ensure that appropriate tracking, verification has been completed throughout program year, e.g., verify that reported measures were actually installed and were not later removed.
• Conduct internal review of program operation focusing on contractor results and potential recommendations regarding using a kit-based approach.

Previous Evaluation Studies:
TAPS Quarterly Installation verification reports
Low Flow Showerhead Load Research Study – Estimating the Impact of Low-Flow Showerhead Installation, SAS Institute (Canada) Inc., April, 2010.</td></tr>
<tr><td>3. Evaluation Elements</td><td>This Evaluation Plan document will be subject to change resulting from discussions through the stakeholder engagement process.

• TAPS Partners Follow-Up Study
The Annual Verification Study is a participant survey completed quarterly in order to confirm which measures were installed and that they were not later removed. Information on this survey also provides verification that contractors are complying with their contractual agreement with Enbridge.

• An evaluation of the contractor capability versus a kit-based approach will be undertaken to inform future programming
.</td></tr>
</table>

	IMPACT EVALUATION ☒ Verification | PROCESS EVALUATION ☒ Program Design & Delivery Review
4. Evaluation Approach	The program administrator (Enbridge) is responsible for the evaluation activities listed above including: • Program tracking and reporting • Verification studies • Other evaluation studies Enbridge will consult with intervenors regarding these evaluation activities as provided through the Board approved DSM Stakeholder Terms of Reference.
5. Special Provisions	No special provisions.
6. Data Collection Responsibilities	Monthly data submissions provided to Enbridge by delivery partners. Data includes: • Address of installation • Type of energy efficient devices installed • Number of energy efficient devices installed • Number of energy efficient devices left for customer install • Completed forms with customer signature acknowledging installation Delivery partners go door to door to offer this free energy savings package. The delivery partners have to complete necessary forms in order to confirm they have delivered and installed the energy efficient measures. Enbridge: Market Development will work with delivery agents in order to qualify Enbridge franchise customers who have not received the TAPS initiative.
7. Evaluation Team	(see table below)

Organization	Name	Title / Accountability
Enbridge	Judith Ramsay	Manager, Research and Evaluation
Enbridge	Corrie Morton	Senior Analyst, Research and Evaluation
Enbridge	Jim Grant	Senior Market Research Analyst
Enbridge	Pam Callow	Program Manager, Market Development
Enbridge	Sharon Moffat	Senior Analyst DSM Reporting

Evaluation Plan

New Construction Energy Savings Kit (ESK) Initiative

Residential Resource Acquisition Program

1. Program Description	**Program Description – See Exhibit B, Tab 1, Schedule 4**
2. Evaluation Goals and Objectives	**Program Theory:** The primary objectives of the 2012 New Construction ESK initiative is to achieve energy saving by providing ESK kits to qualified builders who are NOT Energy Star builders for installation into new build homes. The ESK kit helps the homeowners become aware of energy savings devices available to them and allows the builder to use the kits as a promotional tool. Anticipated outcomes of the program are; • Demonstrate to builders the benefits of the energy efficient technologiess featured in the ESK • Increase customer awareness of the benefits of energy conservation, such as reduced energy usage and associated costs • Promote to builders that Enbridge is there to support them in improving the energy efficiency of the homes they build **Evaluation Goals:** • Provide confidence that program results are accurately tracked and reported • Demonstrate the effectiveness of measures and measure assumptionsto provide confidence that reported results are based on best available information • Assess the effectiveness of the delivery model in order to enhance program effectiveness and participant satisfaction. • Inform long-term DSM program planning **Evaluation Objectives:** • Ensure that appropriate tracking, verification has been completed throughout program year. Confirm participant numbers, input measures and m^3 **Previous Evaluation Studies:** ESK Customer Verification Report, January 2011.

<table>
<tr><td>3. Evaluation Elements</td><td>
This Evaluation Plan document will be subject to change resulting from discussions through the stakeholder engagement process.

ESK Customer Verification Report
The Verification Study is a participant survey completed annually to confirm which Basic Measure efficient products were installed and that they were not later removed.

The objective of the ESK Customer Verification research is to measure:

installation rates of the products,
‘still-installed’ rates (products not removed) and
consumer awareness of products to reduce energy consumption.

Conduct an internal process review to gain understanding on the effectiveness of direct install by builders versus ESK provided to homeowner

<table>
<tr><td>IMPACT EVALUATION
☒ Verification</td><td>PROCESS EVALUATION
☒ Program Design & Delivery Review</td></tr>
</table>
</td></tr>
<tr><td>4. Evaluation Approach</td><td>
The program administrator (Enbridge) is responsible for the evaluation activities listed above including:

Program tracking and reporting
Verification studies
Other evaluation studies

Enbridge will consult with intervenors regarding these evaluation activities as provided through the Board approved DSM Stakeholder Terms of Reference.
</td></tr>
<tr><td>5. Special Provisions</td><td>No special provisions.</td></tr>
<tr><td>6. Data Collection Responsibilities</td><td>
Builder/Customer:
Will provide to Enbridge completed sign off verification form confirming that products were supplied.
Enbridge:
Market Development will provide Research and Evaluation with :

Number of kits per builder
Verification of completed sign-off form

</td></tr>
</table>

7. Evaluation Team	**Organization**	**Name**	**Title / Accountability**
	Enbridge	Judith Ramsay	Manager, Research and Evaluation
	Enbridge	Corrie Morton	Senior Analyst, Research and Evaluation
	Enbridge	Jim Grant	Senior Market Research Analyst
	Enbridge	Mary Harinck	Program Manager, Market Development New Construction
	Enbridge	Sharon Moffat	Senior Analyst DSM Reporting

Evaluation Plan

Commercial Resource Acquisition Program

1. Program Description	**Program Description – See Exhibit B, Tab 1, Schedule 4**
2. Evaluation Goals and Objectives	**Program Theory** Provide new and existing commercial customers with a variety of energy efficiency focused programs aimed at achieving higher levels of energy and environmental performance. There are a number of key barriers to the adoption of energy efficiency in the commercial sector. These include: • Access to capital and related funding constraints, including conflicting investment alternatives; • Lack of awareness regarding the potential savings opportunities; • Lack of information regarding how to identify and implement potential energy savings. This includes accessing consulting engineers to help identify the opportunities and engaging contractors to undertake the retrofits; • Business cycles which capital investments, regardless of energy efficiency opportunity. The commercial sector resource acquisition programs are designed to address these barriers to participation by providing a comprehensive suite of support activities: • Education and awareness of potential savings opportunities and identifying and implementing potential energy savings • Expand programs into new segments and develop channel strategies • Faster and easier access to incentive Initiatives are oriented around 4 main activity areas: • Existing Building Custom Projects • Existing Building Prescriptive Projects • New Construction Custom Projects • New Construction Prescriptive Projects **Evaluation Goals** • Ensure savings estimates reflect appropriate engineering reviews and other studies as appropriate • Provide tracking and reporting consistent with the Board Guidelines • Assess the effectiveness of the delivery model in order to enhance program effectiveness and participation • Inform long-term DSM program planning

<table>
<tr><td></td><td>Evaluation Objectives
Ensure appropriate tracking, verification has been completed throughout program year.
Use evaluation results to inform future DSM planning and to verify savings per the engineering review process and conduct internal review of program operation
Increased awareness among sector customers
Appropriateness of support and incentive from Enbridge
Establish deemed savings estimates for new prescriptive measures
Streamline internal processes</td></tr>
<tr><td>3. Evaluation Elements</td><td>The Evaluation Plan document will be subject to change resulting from discussions through the stakeholder engagement process.
Provide support in the tracking of the Custom and Prescriptive program participants.
Conduct engineering review on a sample of large custom projects as per the Board Guidelines and in consultation with intervenors as per the Board approved terms of Reference for Stakeholder Engagement. Adjust savings claims as appropriate. Assess the need for validation of the various calculation approaches used to estimate savings on custom projects.
Review and assess savings and incremental cost estimates for prescriptive measures. Develop estimates for new measures.
Conduct an internal process review to gain understanding on program design and the effectiveness of the initiative
<table><tr><td>IMPACT EVALUATION

☒ Verification
☒ Custom Project Verification
☒ Energy Savings Analysis</td><td>PROCESS EVALUATION

☒ Program Design & Delivery Review</td></tr></table></td></tr>
<tr><td>4. Evaluation Approach</td><td>The program administrator (Enbridge) is responsible for the evaluation activities listed above including:
Program tracking and reporting
Verification studies, including Engineering Review
Other evaluation studies
Enbridge will consult with Intervenors regarding these evaluation activities as provided through the Board approved DSM Stakeholder Terms of Reference.</td></tr>
<tr><td>5. Special Provisions</td><td>No special provisions.</td></tr>
</table>

Witnesses: A. Mandyam
J. Ramsay

6. Data Collection Responsibilities	Use the Company's current results tracking mechanisms. Enbridge Market Development staff and Energy Solutions Consultants will provide Research and Evaluation with: • Participant numbers • Custom project files for savings calculations and equipment costs • Budget information
7. Evaluation Team	(see table below)

Organization	Name	Title / Accountability
Enbridge	Judith Ramsay	Manager, Research and Evaluation
Enbridge	Rodney Idenouye	Senior Analyst, Research and Evaluation
Enbridge	Walter Matias	Portfolio Manager, Market Development
Enbridge	Various	Program Manager, Market Development
Enbridge	Sharon Moffat	Senior Analyst DSM Reporting
Enbridge	Various	Energy Solutions Consultants

Evaluation Plan

Industrial Resource Acquisition Program

<table>
<tr><td>1. Program Description</td><td>Program Description – See Exhibit B, Tab 1, Schedule 4</td></tr>
<tr><td>2. Evaluation Goals and Objectives</td><td>Program Theory
Provide industrial customers with a variety of energy efficiency focused programs aimed at achieving higher levels of energy and environmental performance.

There are a number of key barriers to the adoption of energy efficiency in the industrial sector. These include:

• The analysis of industrial facilities is complex.
• Customers are not aware of the opportunity or if they are, are not convinced about the magnitude of the potential savings;
• Energy management is not a core business activity and customers do not have in-house expertise to undertake the required activities, or the ability to acquire these resources;
• Larger customers require on-going support to identify and prioritize potential savings and to develop the requisite business case to “sell” the project internally;
• Overall, there is a lack of energy efficiency technical capacity in the industry;.
• Decisions made relating to process improvements are often taken at corporate head offices outside Ontario, not locally;
• Natural gas prices have dropped by 48% relative to 2008 levels
• Information needed to set energy management plans and priorities can be costly.

The industrial sector resource acquisition programs are designed to address these barriers to participation by providing a comprehensive suite of support activities:

• Education and awareness of potential savings opportunities and identifying and implementing potential energy savings, particularly through the use of a continuous improvement approach wherein customers are encouraged to consider holistic energy management solutions.
• Expand programs into new segments focusing on small to medium sized customers and the development of related channel strategies
• Faster and easier access to incentives, including prescriptive incentives.

Initiatives are oriented around two main activity areas:

Custom Projects
Prescriptive Projects</td></tr>
</table>

	Evaluation Goals
	• Ensure savings estimates reflect appropriate engineering reviews and other studies as appropriate
	• Provide tracking and reporting consistent with the Board Guidelines
	• Assess the effectiveness of the delivery model in order to enhance program effectiveness and participation
	• Inform long-term DSM program planning
	
	Evaluation Objectives
	• Ensure appropriate tracking, verification has been completed throughout program year.
	• Update free ridership assumption
	• Use evaluation results to inform future DSM planning and to verify savings per the engineering review process and Board Guidelines
	• Conduct internal overview of program operation
	    • Increased awareness among sector customers
	    • Appropriateness of support and incentive from Enbridge
	    • Establish deemed savings estimates for new prescriptive measures
	    • Streamline internal processes

3. Evaluation Elements	The Evaluation Plan document will be subject to change resulting from discussions through stakeholder engagement process. • Provide support in the tracking of the Custom and Prescriptive program participants. • Conduct engineering review on a sample of large custom projects per the Board Guidelines and oversight through the Board approved stakeholder engagement process. Adjust savings claims as appropriate. Assess the need for validation of the various calculation approaches used to estimate savings on custom projects. • Review and assess savings and incremental cost estimates for prescriptive measures. Develop estimates for new measures. • Conduct a free ridership study delineating free ridership by customer size. • Conduct an internal process review to gain understanding on program design and the effectiveness of the initiative IMPACT EVALUATION ☒ Verification ☒ Custom Project Verification ☒ Energy Savings Analysis PROCESS EVALUATION ☒ Program Design & Delivery Review
4. Evaluation Approach	The program administrator (Enbridge) is responsible for the evaluation activities listed above including: • Program tracking and reporting • Verification studies, including Engineering Review • Other evaluation studies

<table>
<tr><td></td><td>Enbridge will consult with intervenors regarding these evaluation activities as provided through the Board approved DSM Stakeholder Terms of Reference.</td></tr>
<tr><td>5. Special Provisions</td><td>No special provisions.</td></tr>
<tr><td>6. Data Collection Responsibilities</td><td>Use the Company’s current results tracking mechanisms.

Enbridge Market Development staff and Energy Solutions Consultants will provide Research and Evaluation with :
Participant numbers
Custom project files for savings and equipment costs
Budget information</td></tr>
<tr><td>7. Evaluation Team</td><td><table>
<tr><th>Organization</th><th>Name</th><th>Title / Accountability</th></tr>
<tr><td>Enbridge</td><td>Judith Ramsay</td><td>Manager, Research and Evaluation</td></tr>
<tr><td>Enbridge</td><td>Rodney Idenouye</td><td>Senior Analyst, Research and Evaluation</td></tr>
<tr><td>Enbridge</td><td>Daniel Johnson</td><td>Manager, Market Development</td></tr>
<tr><td>Enbridge</td><td>Fei Chen & Various</td><td>Program Manager, Market Development</td></tr>
<tr><td>Enbridge</td><td>Sharon Moffat</td><td>Senior Analyst DSM Reporting</td></tr>
<tr><td>Enbridge</td><td>Various</td><td>Energy Solutions Consultants</td></tr>
</table></td></tr>
</table>

Evaluation Plan

Low Income Program

1. Program Description	**Program Description – See Exhibit B, Tab 1, Schedule 4**
2. Evaluation Goals and Objectives	**Program Theory:** Barriers unique to low income customers and social housing providers discourage customers from making investments in energy conservation and participating in Enbridge Demand Side Management (DSM) initiatives. By designing initiative elements to address these barriers participation in the offerings will be increased and energy savings realized. • Financial barriers will be addressed through the provision of full cost coverage for eligible customers. • Barriers affecting access to the initiatives will be addressed through a variety of approaches: identifying neighbourhoods with a high proportion of low-income families, partnering with other agencies in the community and the possible use of door-to-door installation of basic measures to generate “leads” for installation of deep measures. **Evaluation Goals:** • Provide confidence that program results are accurately tracked and reported • Demonstrate the effectiveness of measures and measure assumptions to provide confidence that reported results are based on best available information • Assess the effectiveness of the delivery model in order to enhance initiative effectiveness and participant satisfaction. • Inform long-term DSM program planning **Evaluation Objectives:** • Ensure that appropriate tracking, verification has been completed throughout the year, e.g., verify that reported measures were actually installed and were not later removed. • Review and update, as appropriate, the prescriptive input assumptions of the measures included in the program • Conduct internal review of program operation. **Previous Evaluation Studies:** TAPS Quarterly Installation verification reports Low Income Weatherization Impact Evaluation – TBD - Fall 2011
3. Evaluation Elements	This Evaluation Plan document will be subject to change resulting from discussions through the stakeholder engagement process. 1. TAPS Partners Follow-Up Study: The Annual Verification Study is a participant survey completed quarterly in order to confirm which Basic

<table>
<tr><td></td><td>Measure efficient products were installed and that they were not later removed. Information on this survey also provides verification that contractors are complying with their contractual agreement with Enbridge.
2. Multi-residential Annual Basic Measures Verification Study: Study design to be determined based on program delivery.
3. Custom Projects Annual Verification Study: The Multi-residential Custom Projects undertaken through the low income program will be included in this verification study. Low income Weatherization Impact Analysis: This Low Income Weatherization Impact evaluation, conducted by a third party will confirm the energy savings reported and claimed, as well as the costs reported by delivery partners. It is anticipated this will start in 2011 and may continue into 2012.
4. Conduct an internal process review to gain understanding on how successfully initiatives were delivered to market.

<table><tr><td>IMPACT EVALUATION
☒ Verification
☒ Custom Project Verification
☒ Energy Savings Analysis</td><td>PROCESS EVALUATION
☒ Program Design & Delivery Review</td></tr></table></td></tr>
<tr><td>4. Evaluation Approach</td><td>The program administrator (Enbridge) is responsible for the evaluation activities listed above including:
• Initiative tracking and reporting
• Verification studies
• Other evaluation studies

Enbridge will consult with Intervenors regarding these evaluation activities as provided through the Board approved DSM Stakeholder Terms of Reference.</td></tr>
<tr><td>5. Special Provisions</td><td>No special provisions.</td></tr>
<tr><td>6. Data Collection Responsibilities</td><td>Monthly data submissions provided to Enbridge by delivery partners. Data includes:

Delivery partners:
• Address of audit/retrofit
• Housing type and Square Footage
• Base Case natural gas consumption
• Measures completed at home
• Cost by measure and total retrofit cost
• Gas savings (m^3) by measure and total gas savings
• Ownership – tracking of private or social assisted

Enbridge:
Market Development will work with delivery agents in order to qualify Enbridge franchise customers who are eligible for the various Low Income initiatives.</td></tr>
</table>

Witnesses: A. Mandyam
J. Ramsay

<table>
<tr><td></td><td>Custom project savings resulting from eligible Part 3 Multi-residential building savings will be submitted by Custom Project application and will be subject to Third Party Engineering review and verification and internal tracking and reporting consistent with current approaches.</td></tr>
<tr><td>7. Evaluation Team</td><td>
<table>
<tr><th>Organization</th><th>Name</th><th>Title / Accountability</th></tr>
<tr><td>Enbridge</td><td>Judith Ramsay</td><td>Manager, Research and Evaluation</td></tr>
<tr><td>Enbridge</td><td>Corrie Morton</td><td>Senior Analyst, Research and Evaluation</td></tr>
<tr><td>Enbridge</td><td>Jim Grant</td><td>Senior Market Research Analyst</td></tr>
<tr><td>Enbridge</td><td>Erika Lontoc</td><td>Manager, DSM Reporting and Analysis</td></tr>
<tr><td>Enbridge</td><td>Sharon Moffat</td><td>Senior Analyst DSM Reporting</td></tr>
</table>
</td></tr>
</table>

Evaluation Plan

DrainWater Heat Recovery Program

Market Transformation Program Type

1. Program Description	**Program Description – See Exhibit B, Tab 1, Schedule 4**
2. Evaluation Goals and Objectives	**Program Theory** Provide builder incentives and training to achieve widespread installation of Drain Water Heat Recovery (DWHR) in residential new construction low rise homes in the Enbridge franchise territory. Also, use the DWHR program as a door opener for the Company's new Integrated Design Process (IDP) initiative being launched in 2012. It is expected that some of the builder participants in the DWHR program will also be recruited into the IDP program. Program Logic Model The program logic model will be updated in 2012 to demonstrate the program theory and the planned relationships between the program objective, program elements and how they will work together to facilitate the programs goals. **Evaluation Goals** • Update the current program theory/logic model • Assess the effectiveness of the delivery model in order to enhance program effectiveness and participation • Inform long-term DSM program planning to ensure exit strategy is appropriate **Evaluation Objectives** • Ensure appropriate tracking, verification has been completed throughout program year. • Confirm number of units installed • Use evaluation results to verify program exit strategy • Conduct internal review of program operation to assess: o Increased awareness among builders, o Increased knowledge regarding installation requirements and number of trades contractors installing units, and o Appropriateness of incentive level.
3. Evaluation Elements	The Evaluation Plan document will be subject to change resulting from discussions through the stakeholder engagement process. 1. Provide support in the tracking of the 2012 DWHR units installed Tracking of units installed will be completed by Enbridge and based on information obtained from the delivery partners and serial numbers on DWHR units.

Witnesses: A. Mandyam
J. Ramsay

<table>
<tr><td></td><td>Monthly reporting of participant numbers will be completed.
2. Conduct an internal process review to gain understanding of the effectiveness of the initiative
3. Monthly Variance analysis - evaluates program targets and budget for upcoming year due to number of units installed and market penetration.

<table><tr><td>IMPACT EVALUATION
☒ Verification
Custom Project Verification
Energy Savings Analysis</td><td>PROCESS EVALUATION
☒ Program Design & Delivery Review</td></tr></table></td></tr>
<tr><td>4. Evaluation Approach</td><td>Enbridge Market Development and DSM Research and Evaluation will be responsible for all Evaluation activities required as listed above.</td></tr>
<tr><td>5. Special Provisions</td><td>No special provisions.</td></tr>
<tr><td>6. Data Collection Responsibilities</td><td>Enbridge Market Development staff will
• qualify and enroll builders who are eligible for the DWHR initiative, and
• gather all information submitted monthly by the various delivery agents to provide a participant summary of the number of units installed.

This information will be recorded on a quarterly spreadsheet maintained by Market Development to report and update the variance tracking for unit numbers, budget and SSM target.

Market Development will provide Research and Evaluation with :
• Units Installed
• Budget information
Reporting and Analysis will provide Market Development with:
• Monthly Variance reports</td></tr>
<tr><td>7. Evaluation Team</td><td><table><tr><th>Organization</th><th>Name</th><th>Title / Accountability</th></tr><tr><td>Enbridge</td><td>Judith Ramsay</td><td>Manager, Research and Evaluation</td></tr><tr><td>Enbridge</td><td>Corrie Morton</td><td>Senior Analyst, Research and Evaluation</td></tr><tr><td>Enbridge</td><td>Shannon Bertuzzi</td><td>Portfolio Manager, Growth and New Construction</td></tr><tr><td>Enbridge</td><td>Mary Harinck</td><td>Program Manager, Growth and New Construction</td></tr><tr><td>Enbridge</td><td>Sharon Moffat</td><td>Senior Analyst DSM Reporting</td></tr></table></td></tr>
</table>

Witnesses: A. Mandyam
J. Ramsay

Evaluation Plan

Savings by Design Program, Residential New Construction

Market Transformation Program Type

1. Program Description	**Program Description – See Exhibit B, Tab 1, Schedule 4**
2. Evaluation Goals and Objectives	**Program Theory** Encourage builders to leverage an Integrated Design Process ("IDP") to ultimately build new homes that are 25% better than existing building 2012 Code homes, leading to the adoption of higher energy efficiency levels in the Ontario Building Code ("OBC"). Builders are apprehensive from participating in energy efficient programs due to time, money and lack of knowledge on how to build beyond code. By designing program elements to address these barriers, participation in programs will be increased and energy savings realized • IDP top demonstrate to builders the potential for achieving higher levels of energy and environmental performance • Support with performance incentives that encourage builders to build new homes that are 25% better than Code • Provide workshop to builders on IDP process • Support Industry capability to deliver IDP via support for sector associations who provide training It is expected that some of the builder participants in the DWHR program will also be recruited to participate in the IDP program. Program Logic Model The program logic model will be developed for 2012 to demonstrate the program theory and the planned relationships between the program objective, program elements and how they will work together to facilitate the programs goals. **Evaluation Goals** • Develop a program theory/logic model • Provide confidence that the reported results are based on the best available information • Assess the effectiveness of the delivery model in order to enhance program effectiveness and participation • Assess the transformative features of the initiative • Inform long-term DSM program planning **Evaluation Objectives** • Ensure appropriate tracking, verification has been completed throughout the program year.

<table>
<tr><td></td><td>

Confirm number of builders participating in the IDP are verified with builder objective
Use evaluation results to inform future DSM planning
Conduct internal review of program operation

Program awareness among builders
Appropriateness of support and incentive from Enbridge
Ease of IDP process for builders
Develop a plan for confirming energy savings calculated by energy rater

</td></tr>
<tr><td>3. Evaluation Elements</td><td>
The Evaluation Plan document will be subject to change resulting from discussions through the stakeholder engagement process.

Provide support in the tracking of the 2012 builders enrolled in each category. Tracking of builders/developers completing the IDP process as part of the initiative delivery will be completed by Enbridge. Supporting IDP documents will establish estimated savings versus OBC homes. Monthly reporting of builder numbers will be completed.
Conduct an internal process review to gain understanding on program design and the effectiveness of the initiative
Monthly Variance analysis - evaluate budget for upcoming year due to number of builders and market penetration.

<table>
<tr><td>IMPACT EVALUATION
☒ Verification</td><td>PROCESS EVALUATION
☒ Program Design & Delivery Review</td></tr>
</table>
</td></tr>
<tr><td>4. Evaluation Approach</td><td>
The program administrator (Enbridge) is responsible for the evaluation activities listed above including:

Program tracking and reporting
Verification studies
Other evaluation studies

Enbridge will consult with intervenors regarding these evaluation activities as provided through the Board approved DSM Stakeholder Terms of Reference.
</td></tr>
<tr><td>5. Special Provisions</td><td>No special provisions.</td></tr>
<tr><td>6. Data Collection Responsibilities</td><td>
Enbridge Market Development staff will qualify and enroll builders who are eligible for the IDP process.
Market Development will gather all information submitted monthly to provide a participant summary of the number of builders enrolled.
This information will be entered on a quarterly spreadsheet maintained by Market Development to report and update the variance tracking for builder numbers, budget and performance target.
</td></tr>
</table>

Witnesses: A. Mandyam
J. Ramsay

	Market Development will provide Research and Evaluation with : • Builders Enrolled • Budget information
7. Evaluation Team	(see table below)

Organization	Name	Title / Accountability
Enbridge	Judith Ramsay	Manager, Research and Evaluation
Enbridge	Corrie Morton	Senior Analyst, Research and Evaluation
Enbridge	Shannon Bertuzzi	Portfolio Manager, Market Development and Growth
Enbridge	Mary Harinck	Program Manager, Market Development
Enbridge	Sharon Moffat	Senior Analyst DSM Reporting

Evaluation Plan

Home Labelling Program, Existing Residential Homes

Market Transformation Program Type

1. Program Description	**Program Description – See Exhibit B, Tab 1, Schedule 4**

2. Evaluation Goals and Objectives	**Program Theory**
	To raise awareness and understanding among home buyers and sellers of the importance of the Home Labelling in order for it to become a common condition of sale similar to home inspections.
	
	By designing program elements to raise awareness and understanding, participation in programs will be increased and energy savings realized.
	
	• Training and Education – real estate community, home owners, home inspection companies, energy raters, municipalities, financial institutions, etc.
	• Promotion to realtors, energy raters, home inspection firms and existing residential customers
	• Energy Rating listed on Multiple Listing Services or similar
	• Real Estate agents promoting offers to be subject to energy assessment
	
	<u>Program Logic Model</u>
	The program logic model will be completed in 2012 to demonstrate the program theory and the planned relationships between the program objective, program elements and how they will work together to facilitate the programs goals.
	
	Evaluation Objectives
	• Develop program theory/logic model
	• Tracking number of commitments to participate/number of listings
	• Market research to assess the effectiveness of the delivery model in order to enhance program effectiveness and participation
	• Ensure appropriate tracking, verification has been completed throughout program year.
	• Confirm number of commitments/listings
	• Use evaluation results to inform future DSM planning
	• Conduct internal review of program operation
	    ◦ Increased awareness
	    ◦ Feedback from realtors regarding endorsement
	    ◦ Market research results
	    ◦ Training plan in place

<table>
<tr><td>3. Evaluation Elements</td><td>
The Evaluation Plan document will be subject to change resulting from discussions through stakeholder engagement process.
Provide support in the tracking of commitments/listings
Tracking of commitments and feedback from realtors collected
Conduct an internal process review to gain understanding on program design and the effectiveness of the initiative
As this is a new initiative, the 2012 process evaluation will focus on the assessment of 1 key element – Market Feedback
<table>
<tr><td>IMPACT EVALUATION
☒ Verification
☒ Market Effects Assessment</td><td>PROCESS EVALUATION
☒ Program Design & Delivery Review</td></tr>
</table>
</td></tr>
<tr><td>4. Evaluation Approach</td><td>
The program administrator (Enbridge) is responsible for the evaluation activities listed above including:
Program tracking and reporting
Other evaluation studies
Enbridge will consult with intervenors regarding these evaluation activities as provided through the Board approved DSM Stakeholder Terms of Reference of Stakeholder Engagement
</td></tr>
<tr><td>5. Special Provisions</td><td>No special provisions.</td></tr>
<tr><td>6. Data Collection Responsibilities</td><td>
Enbridge Market Development staff will work with industry personnel in order to complete market research to enhance future program delivery.
Market Development and Research staff will collate all information submitted monthly to provide a participant summary of the number of listing services participating and number of homes listed
This information will be recorded on a quarterly spreadsheet maintained by Market Development to report and update the variance tracking of budget and performance target.
Market Development will provide Research and Evaluation with:
Listing services participation
Budget information
</td></tr>
</table>

7. Evaluation Team	**Organization**	**Name**	**Title / Accountability**
	Enbridge	Judith Ramsay	Manager, Research and Evaluation
	Enbridge	Corrie Morton	Senior Analyst, Research and Evaluation
	Enbridge	Bill Chihata	Manager, Market Development
	Enbridge	Pamela Callow	Program Manager, Market Development
	Enbridge	Sharon Moffat	Senior Analyst DSM Reporting

Evaluation Plan

Savings by Design Program, Commercial New Construction

Market Transformation Program Type

<table>
<tr><td>1. Program Description</td><td>Program Description – See Exhibit B, Tab 1, Schedule 4</td></tr>
<tr><td>2. Evaluation Goals and Objectives</td><td>Program Theory
Encourage builders/developers to use the knowledge gained in the Integrated Design Process (“IDP”) to design and construct buildings that are more energy efficient than the current Code buildings, ultimately leading to the adoption of higher energy efficiency levels in the Ontario Building Code (“OBC”).

Builders are reluctant to participate in energy efficient programs due to time, money and/or lack of knowledge on how to build beyond code.

By designing program elements to address these barriers, participation in programs will be increased and energy savings realized.
• IDP to demonstrate to builders/developers the potential for achieving higher levels of energy and environmental performance
• Support with performance incentives that encourage builders / developers to build new commercial buildings that exceed OBC efficiency levels
• Provide workshop to builders on IDP process
• Support Industry capability to deliver IDP via support for sector associations, design professionals etc.

<u>Program Logic Model</u>
The program logic model will be developed for 2012 to demonstrate the program theory and the planned relationships between the program objective, program elements and how they will work together to facilitate the programs goals.

Evaluation Goals
• Develop a program theory/logic model
• Provide confidence that the reported results are based on the best available information
• Assess the effectiveness of the delivery model in order to enhance program effectiveness and participation
• Assess the transformative features of the initiative
• Inform long-term DSM program planning

Evaluation Objectives

• Ensure appropriate tracking, verification has been completed throughout program year.
• Confirm number of builders/developers for metric
• Conduct internal review of program operation</td></tr>
</table>

<table>
<tr><td></td><td>

Increased awareness among builders/developers
Appropriateness of support and incentive from Enbridge
Ease of IDP process for builders/developers
Develop a plan for measuring gas savings against the modeled estimate

Use evaluation results to inform future DSM planning

</td></tr>
<tr><td>3. Evaluation Elements</td><td>
The Evaluation Plan document will be subject to change resulting from discussions through stakeholder engagement process.

1. Provide support in the tracking of the 2012 builders/developers completing IDP process. Tracking of builders/developers completing the IDP process as part of the initiative delivery will be completed by Enbridge. Supporting IDP documents will provide preliminary estimates of energy savings. Monthly reporting of builder/developer numbers will be completed.
2. Conduct an internal process review to gain understanding on program design and the effectiveness of the initiative
3. Monthly Variance analysis - evaluate budget for upcoming year due to number of builders and market penetration.

<table>
<tr><td>IMPACT EVALUATION
☒ Verification</td><td>PROCESS EVALUATION
☒ Program Design & Delivery Review</td></tr>
</table>
</td></tr>
<tr><td>4. Evaluation Approach</td><td>
The program administrator (Enbridge) is responsible for the evaluation activities listed above including:

Program tracking and reporting
Verification studies
Other evaluation studies

Enbridge will consult with Intervenors regarding these evaluation activities as provided through the Board approved DSM Stakeholder Terms of Reference.
</td></tr>
<tr><td>5. Special Provisions</td><td>No special provisions.</td></tr>
<tr><td>6. Data Collection Responsibilities</td><td>
Enbridge Market Development staff will qualify, enroll, and complete the IDP process with builders/developers who are eligible.

Market Development staff will gather all information submitted monthly to provide a participant summary of the number of builders/developers with completed IDP's.

This information will be recorded on a quarterly spreadsheet maintained by Market Development to report and update the variance tracking for builder numbers, budget and SSM target.
</td></tr>
</table>

	Market Development will provide Research and Evaluation with: • Builders with IDP complete • Budget information
7. Evaluation Team	(see table below)

Organization	Name	Title / Accountability
Enbridge	Judith Ramsay	Manager, Research and Evaluation
Enbridge	Corrie Morton	Senior Analyst, Research and Evaluation
Enbridge	Shannon Bertuzzi	Portfolio Manager, Market Development and Growth
Enbridge	Mary Harinck	Program Manager, Market Development
Enbridge	Sharon Moffat	Senior Analyst DSM Reporting

Witnesses: A. Mandyam
J. Ramsay

STAKEHOLDER ENGAGEMENT TERMS OF REFERENCE

1. The Framework for the current Multi-year plan provided for Stakeholder Engagement through a minimum of two Consultative meetings each year and through establishment of an Evaluation Audit Committee (“EAC”) to play an advisory role in the Demand Side Management (“DSM”) audit process and in evaluation research.

2. The new DSM Guidelines have three main features regarding Stakeholder Engagement:[1]

   a. Affirmation that “The natural gas utilities are ultimately responsible and accountable for their DSM activities and, accordingly, consultative activities should be undertaken at the discretion of the natural gas utilities.”
   b. A recommended minimum stakeholder engagement in the form of a minimum of two General DSM meetings each year.
   c. A requirement for the utilities to develop Terms of Reference (“ToR) for the stakeholder engagement process “in cooperation with their stakeholders” and to submit the Terms of Reference with the multi-year DSM plan application.

3. In compliance with the DSM Guidelines, Enbridge and Union Gas Limited undertook consultation with Intervenors to develop the Terms of Reference. Enbridge convened a meeting of the DSM Consultative on July 20th, 2011 at which time the Consultative nominated five members to a Working Group to meet with the utilities. The Working Group held four half day sessions and a two hour conference call in August.

[1] Demand Side Management Guidelines for Natural Gas Utilities, EB-2008-0346, Ontario Energy Board, June 30, 2011, page 42.

4. Consensus was not reached in this initial round of discussions and Union filed a proposed Terms of Reference with their 2012 to 2014 DSM Plan on September 23rd, 2011.

5. On September 21st, 2011, Enbridge convened a meeting of the DSM Consultative and the Consultative agreed to reopen discussions on the Terms of Reference. Working in plenary session, the Consultative and the utilities held two full day meetings on October 3rd and 4th, 2011.

6. Following the meetings, Enbridge and Union worked with parties to develop a document that would be acceptable to all. The Terms of Reference attached as "Appendix A" to the Settlement Agreement (Exhibit B, Tab 2, Schedule 9) is the result of this process.

7. The Terms of Reference address all the requirements for stakeholder engagement as set out in the Guidelines. They include:
    a. Provision for a minimum of two General DSM Meetings a year;
    b. Stakeholder involvement in:
        - Establishment and review of evaluation priorities and plans,
        - Review of evaluation study designs,
        - Selection of the DSM auditor, and
    c. Preparation of a "Stakeholder Report" following the DSM audit.

    In addition, the Terms of Reference provide for stakeholder involvement in:
    - Development and update of input assumptions, and
    - Development of new DSM program ideas.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

8. The Terms of Reference also introduce a significant innovation in the form of a shared Technical Evaluation Committee for both utilities and the development of a common Technical Reference Manual. Each utility will continue to have a separate Audit Committee.

9. The complete Terms of Reference may be found at Appendix A of the Enbridge Settlement Agreement (Exhibit B, Tab 2, Schedule 9).

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

SYSTEM CHARACTERISTICS AND RATE ALLOCATION

1. This section provides information on the Enbridge Gas Distribution Inc. system characteristics and on rate allocation of Demand Side Management ("DSM") costs.

2. Table 1 on page 2, shows, as suggested by the Ontario Energy Board's guideline in the *"Demand Side Management Guidelines for Natural Gas Utilities"* the following:
   a. "The total amount of DSM spending to be recovered in rates and the allocation of those costs to the customer class(es) that will benefit from the DSM program applied for;
   b. A forecast of the number of customers in each class and a forecast of m3 of natural gas to be used as a charge determinant for the rate rider of each rate class to benefit from the DSM program(s); and
   c. A comparison of the proposed rates with and without the DSM rate rider for the rate year in question."

   Item (c.) is shown as the unit rate variance for DSM.

3. Table 2 on page 3 shows the allocation of program direct costs by targeted customer classes.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

2012 Program Year

Item No.		Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8	Col. 9	Col. 10	Col. 11	Col. 12
		Total	RATE 1	RATE 6	RATE 9	RATE 100	RATE 110	RATE 115	RATE 125	RATE 135	RATE 145	RATE 170	RATE 300
1.0	*a) Total Amount of DSM Spending*												
1.1	DSM Programs ($M)	23.88	7.47	13.59	-	-	1.01	0.25	-	0.07	0.74	0.76	-
1.2	Low Income Base Programs ($M)	4.22	2.87	1.19	0.00	-	0.04	0.02	0.03	0.00	0.03	0.02	0.00
1.3	Low Income Incremental Programs ($M)	2.81	1.91	0.79	0.00	-	0.03	0.02	0.02	0.00	0.02	0.01	0.00
1.4	Total 2012 DSM Budget	30.91	12.25	15.57	0.00	-	1.08	0.29	0.05	0.08	0.78	0.80	0.00
2.0	*b) 2012 Forecast*												
2.1	i) Number of Customers	1,984,734	1,826,796	157,500	9	-	201	30	5	38	108	38	8
2.2	ii) Annual Deliveries (10^3m^3)	11,268,896	4,583,338	4,772,169	1,177	-	488,031	532,453	-	55,183	154,354	519,974	-
3.0	*c) Comparison of Proposed Rates w/ & w/o DSM*												
3.1	Unit rate variance for DSM (cents/m3)*	0.2743	0.2672	0.3262	0.1194		0.2213	0.0539		0.1436	0.5055	0.1529	
3.2	Annual Bill Impact for Typical Customer($)		$8	$74	$405	$0	$1,325	$2,412	$10,538	$859	$3,026	$15,257	$439

*Note:
Unit rates calculated as Total 2012 DSM Budget (Item 1.4) divided by Annual Deliveries (Item 2.2).
For Unbundled Rates 125 & 300, costs are recovered through contract demand charges. The average amount per customer corresponds to amounts shown on Item 3.2, columns 8 and 12.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

2012 DSM PLAN
PROGRAM DIRECT COSTS ALLOCATED BY RATE CLASS

Program Type	Sector	Program	Direct Costs (Variable Incentives)	'RATE 1	'RATE 6	'RATE 110	'RATE 115	'RATE 125	'RATE 135	'RATE 145	'RATE 170
Resource Acquisition											
	Residential Total		**$2,433,000**	**$2,433,000**							
	Commercial Total		**$4,580,965**		**$4,122,868**	**$47,184**				**$199,272**	**$211,641**
	Industrial Total		**$3,054,211**		**$1,631,975**	**$674,675**	**$182,336**		**$54,670**	**$255,332**	**$255,332**
Resource Acquisition Total			**$10,068,176**	**$2,433,000**	**$5,754,843**	**$721,859**	**$182,336**		**$54,670**	**$454,604**	**$466,973**
Low Income											
Low Income Total			**$4,438,150**	**$3,017,498**	**$1,249,783**	**$44,825**	**$24,854**	**$33,286**	**$3,107**	**$27,960**	**$22,191**
Market Transformation											
		Home labelling		$0							
		DWHR	$1,600,000	$1,600,000							
		Savings By Design - Residentia	$165,000	$165,000							
		LNC Savings by Design	$220,000		$198,000	$2,266				$9,570	$10,164
Market Transformation Total			**$1,985,000**	**$1,765,000**	**$198,000**	**$2,266**				**$9,570**	**$10,164**
Grand Total			**$16,491,326**	**$7,215,498**	**$7,202,626**	**$768,950**	**$207,190**	**$33,286**	**$57,777**	**$492,134**	**$499,327**

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

AVOIDED COSTS

1. In Phase III of the EB-2006-0021Natural Gas Demand Side Management Generic Issues proceeding (“DSM Generic Proceeding”), the Company submitted avoided cost calculations for natural gas, water and electricity for 2007. In accordance with the Demand Side Management (“DSM”) Guidelines approved by the Ontario Energy Board (the “Board”) in the DSM Generic Proceeding (EB-2006-0021, Phase I), the Company updated the commodity portion of the avoided costs in the fourth quarter of each year for application to the next year.

2. For the 2012 year, the Company is following this same approach. Since 2012 is the beginning of a new multi-year plan, the Company is undertaking a complete update of the avoided natural gas costs, including the costs for transportation and storage as well as the commodity costs. This update will follow the methodology approved in the DSM Generic Proceeding (EB-2006-0021). Similarly, the Company is undertaking an update to the avoided electricity and water costs, using the methodology approved in DSM Generic Proceeding (EB-2006-0021). .

3. The updated avoided costs will be available later in the fourth quarter. In the interim, the Company has applied the avoided costs for 2011 for the purpose of completing the TRC analysis included in this submission. The Company will file the updated avoided costs as soon as they are available, together with an updated TRC analysis. It is not anticipated that the update to avoided costs will have a material impact on the TRC analysis.

2011 Avoided Cost Summary

	Year	Water Heating Avoided Costs	Water Heating NPV	Space Heating Avoided Costs	Space Heating NPV	Space & Water Heating Avoided Costs	Space & Water Heating NPV	Industrial Avoided Costs	Industrial NPV
1	2011	$ 0.1762	$0.18	$ 0.1945	$0.19	$ 0.1912	$0.19	$ 0.1785	$0.18
2	2012	$ 0.1561	$0.32	$ 0.1707	$0.35	$ 0.1679	$0.35	$ 0.1581	$0.32
3	2013	$ 0.2056	$0.49	$ 0.2240	$0.54	$ 0.2206	$0.53	$ 0.2079	$0.50
4	2014	$ 0.2170	$0.66	$ 0.2393	$0.72	$ 0.2354	$0.71	$ 0.2195	$0.67
5	2015	$ 0.2286	$0.82	$ 0.2520	$0.90	$ 0.2478	$0.89	$ 0.2311	$0.83
6	2016	$ 0.2394	$0.97	$ 0.2639	$1.07	$ 0.2595	$1.05	$ 0.2420	$0.99
7	2017	$ 0.2363	$1.11	$ 0.2605	$1.23	$ 0.2561	$1.21	$ 0.2389	$1.13
8	2018	$ 0.2241	$1.24	$ 0.2470	$1.36	$ 0.2429	$1.34	$ 0.2266	$1.25
9	2019	$ 0.2141	$1.34	$ 0.2360	$1.48	$ 0.2321	$1.45	$ 0.2165	$1.36
10	2020	$ 0.2184	$1.44	$ 0.2408	$1.59	$ 0.2368	$1.56	$ 0.2208	$1.46
11	2021	$ 0.2228	$1.53	$ 0.2456	$1.69	$ 0.2415	$1.66	$ 0.2252	$1.55
12	2022	$ 0.2272	$1.62	$ 0.2505	$1.78	$ 0.2463	$1.75	$ 0.2297	$1.64
13	2023	$ 0.2318	$1.70	$ 0.2555	$1.87	$ 0.2512	$1.84	$ 0.2343	$1.72
14	2024	$ 0.2364	$1.78	$ 0.2606	$1.96	$ 0.2563	$1.92	$ 0.2390	$1.80
15	2025	$ 0.2411	$1.85	$ 0.2658	$2.04	$ 0.2614	$2.00	$ 0.2438	$1.87
16	2026	$ 0.2460	$1.92	$ 0.2711	$2.11	$ 0.2666	$2.07	$ 0.2487	$1.94
17	2027	$ 0.2509	$1.98	$ 0.2766	$2.18	$ 0.2720	$2.14	$ 0.2537	$2.00
18	2028	$ 0.2559	$2.04	$ 0.2821	$2.24	$ 0.2774	$2.20	$ 0.2587	$2.06
19	2029	$ 0.2610	$2.09	$ 0.2877	$2.30	$ 0.2829	$2.26	$ 0.2639	$2.11
20	2030	$ 0.2662	$2.14	$ 0.2935	$2.36	$ 0.2886	$2.32	$ 0.2692	$2.16
21	2031	$ 0.2716	$2.19	$ 0.2994	$2.41	$ 0.2944	$2.37	$ 0.2746	$2.21
22	2032	$ 0.2770	$2.23	$ 0.3053	$2.46	$ 0.3003	$2.42	$ 0.2801	$2.26
23	2033	$ 0.2825	$2.27	$ 0.3115	$2.50	$ 0.3063	$2.46	$ 0.2857	$2.30
24	2034	$ 0.2882	$2.31	$ 0.3177	$2.54	$ 0.3124	$2.50	$ 0.2914	$2.34
25	2035	$ 0.2939	$2.35	$ 0.3240	$2.58	$ 0.3186	$2.54	$ 0.2972	$2.37
26	2036	$ 0.2998	$2.38	$ 0.3305	$2.62	$ 0.3250	$2.58	$ 0.3031	$2.41
27	2037	$ 0.3058	$2.41	$ 0.3371	$2.66	$ 0.3315	$2.61	$ 0.3092	$2.44
28	2038	$ 0.3119	$2.44	$ 0.3439	$2.69	$ 0.3381	$2.64	$ 0.3154	$2.47
29	2039	$ 0.3182	$2.47	$ 0.3508	$2.72	$ 0.3449	$2.67	$ 0.3217	$2.50
30	2040	$ 0.3245	$2.49	$ 0.3578	$2.75	$ 0.3518	$2.70	$ 0.3281	$2.52

Discount Rate: 9.14%

	Year	Ont. CPI	Electricity ¢ / Kwh	Electricity NPV	Water Rates $ / 1000 litres	Water NPV
1	2011	2.41	$ 0.0861	$0.09	$ 1.7220	$1.72
2	2012	2.06	$ 0.0879	$0.17	$ 1.7574	$3.33
3	2013	2.26	$ 0.0899	$0.24	$ 1.7971	$4.84
4	2014	2.10	$ 0.0917	$0.31	$ 1.8349	$6.25
5	2015	2.08	$ 0.0937	$0.38	$ 1.8731	$7.57
6	2016	2.01	$ 0.0955	$0.44	$ 1.9108	$8.81
7	2017	1.93	$ 0.0974	$0.50	$ 1.9477	$9.96
8	2018	1.97	$ 0.0993	$0.55	$ 1.9860	$11.04
9	2019	2.04	$ 0.1013	$0.60	$ 2.0265	$12.04
10	2020	2.11	$ 0.1035	$0.65	$ 2.0693	$12.98
11	2021	2.09	$ 0.1056	$0.69	$ 2.1125	$13.87
12	2022	2.10	$ 0.1078	$0.73	$ 2.1570	$14.69
13	2023	2.12	$ 0.1101	$0.77	$ 2.2026	$15.46
14	2024	2.15	$ 0.1125	$0.81	$ 2.2499	$16.18
15	2025	2.10	$ 0.1149	$0.84	$ 2.2971	$16.86
16	2026	2.19	$ 0.1174	$0.87	$ 2.3473	$17.49
17	2027	2.21	$ 0.1200	$0.90	$ 2.3991	$18.08
18	2028	2.25	$ 0.1227	$0.93	$ 2.4532	$18.64
19	2029	2.19	$ 0.1254	$0.96	$ 2.5070	$19.16
20	2030	2.22	$ 0.1281	$0.98	$ 2.5625	$19.64
21	2031	2.00	$ 0.1307	$1.00	$ 2.6138	$20.10
22	2032	2.00	$ 0.1333	$1.03	$ 2.6661	$20.52
23	2033	2.00	$ 0.1360	$1.05	$ 2.7194	$20.92
24	2034	2.00	$ 0.1387	$1.06	$ 2.7738	$21.29
25	2035	2.00	$ 0.1415	$1.08	$ 2.8293	$21.64
26	2036	2.00	$ 0.1443	$1.10	$ 2.8858	$21.96
27	2037	2.00	$ 0.1472	$1.11	$ 2.9436	$22.26
28	2038	2.00	$ 0.1501	$1.13	$ 3.0024	$22.55
29	2039	2.00	$ 0.1531	$1.14	$ 3.0625	$22.81
30	2040	2.00	$ 0.1562	$1.15	$ 3.1237	$23.06

Discount Rate: 9.14%

Witnesses: A. Mandyam
J. Ramsay

TOTAL RESOURCE ANALYSIS

1. This section presents the Total Resource Cost ("TRC") analysis of the programs in the portfolio Enbridge Gas Distribution Inc. (the "Company" or "Enbridge") Demand Side Management ("DSM") programs.

2. Table 1 on page 2, shows the TRC analysis and TRC Ratio by program with some additional detail at the program initiative level. This analysis includes indirect program costs such as program development, start-up and promotion costs and overhead costs at the program and the portfolio level.

3. Table 2 on page 3 to 10, provides the TRC analysis of each of the Enbridge measures in the Table of Measure Assumptions found at Exhibit B, Tab 2, Schedule 4 and follows the same sequence as presented in the Table of Measure assumptions. The TRC analysis for each measure is based on one participant and includes the measure incremental costs but does not include indirect costs or overhead costs which are allocated at the program or portfolio level.

Witnesses: P. Goldman
A. Mandyam
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S. Surdu

2012 DSM PLAN
TRC ANALYSIS - COST EFFECTIVENESS RESULTS

Program Type	Sector	Program	NPV Gas	NPV Electric	NPV Water	Total Benefits @ Zero Emissions	Indirect Program Costs (Fixed)	Program OH (Fixed)	Total Fixed Costs	Total Incremental Costs (net)	General Admin Costs	Total TRC Costs	Net TRC Benefits (incldg OH) @ Zero Emissions	TRC Ratio
RESOURCE ACQUISITION														
	Residential													
		Community Energy	$240,878	$0	$0	$240,878	$180,000	$45,132	$225,132	$160,000		$385,132	-$144,254	0.63
		TAPS	$6,295,323	$0	$19,307,723	$25,603,047	$195,000	$45,132	$240,132	$1,623,150		$1,863,282	$23,739,765	13.74
		ESKs	$193,921	$34,358	$135,522	$363,801	$0	$21,788	$21,788	$31,620		$53,408	$310,393	6.81
	Residential Total		**$6,730,123**	**$34,358**	**$19,443,246**	**$26,207,726**	**$375,000**	**$112,052**	**$487,052**	**$1,814,770**		**$2,301,823**	**$23,905,903**	**11.39**
	Commercial													
		Prescriptive Boilers	$7,569,406	$0	$0	$7,569,406	$25,000	$40,742	$65,742	$1,305,498		$1,371,239	$6,198,167	5.52
		Prescriptive HVAC	$5,694,943	$0	$0	$5,694,943	$25,000	$40,742	$65,742	$3,397,716		$3,463,458	$2,231,485	1.64
		Prescriptive Large Boilers	$9,840,228	$0	$0	$9,840,228	$25,000	$40,742	$65,742	$2,689,760		$2,755,501	$7,084,727	3.57
		Prescriptive Other	$1,824,867	$8,694	$34,777	$1,868,338	$25,000	$40,742	$65,742	$1,350,772		$1,416,513	$451,825	1.32
		Prescriptive Water	$3,080,335	$897,773	$5,081,973	$9,060,081	$25,000	$40,742	$65,742	$731,251		$796,993	$8,263,088	11.37
		Custom	$36,291,802	$0	$0	$36,291,802	$1,009,824	$244,449	$1,254,273	$13,793,657		$15,047,930	$21,243,872	2.41
		LNC Prescriptive	$1,285,482	$0	$0	$1,285,482	$50,000	$14,525	$64,525	$493,748		$558,274	$727,209	2.30
		LNC NBCP Legacy Projects	$6,298,862	$0	$0	$6,298,862	$0	$14,525	$14,525	$259,000		$273,525	$6,025,337	23.03
		Run it Right	$0	$0	$0	$0	$1,500,000	$162,966	$1,662,966	$0		$1,662,966	-$1,662,966	0.00
		Energy Compass	$0	$0	$0	$0	$400,000	$162,966	$562,966	$0		$562,966	-$562,966	0.00
		C/I Competition	$0	$0	$0	$0	$500,000	$40,742	$540,742	$0		$540,742	-$540,742	0.00
	Commercial Total		**$71,885,926**	**$906,468**	**$5,116,750**	**$77,909,143**	**$3,584,824**	**$843,882**	**$4,428,706**	**$24,021,402**		**$28,450,107**	**$49,459,036**	**2.74**
	Industrial													
		Custom	$35,070,011	$0	$0	$35,070,011	$897,000	$731,120	$1,628,120	$3,073,857		$4,701,977	$30,368,035	7.46
		Prescriptive (Air Doors)	$944,647	$0	$0	$944,647	$200,000	$81,236	$281,236	$326,002		$607,238	$337,409	1.56
	Industrial Total		**$36,014,658**	**$0**	**$0**	**$36,014,658**	**$1,097,000**	**$812,355**	**$1,909,355**	**$3,399,859**		**$5,309,214**	**$30,705,444**	**6.78**
RESOURCE ACQUISITION TOTAL			**$114,630,707**	**$940,825**	**$24,559,996**	**$140,131,528**	**$5,056,824**	**$1,768,289**	**$6,825,113**	**$29,236,031**		**$36,061,144**	**$104,070,384**	**3.89**
LOW INCOME														
	Residential Weatherization (LI)		$2,225,405	$0	$198,027	$2,423,432	$610,000	$143,176	$753,176	$94,284		$847,460	$1,575,972	2.86
	Multi-Residential													
		Part 3 TAPS	$273,596	$0	$419,567	$693,163	$0	$0	$0	$33,750		$33,750	$659,413	20.54
		Part 3 Custom	$6,674,486	$0	$0	$6,674,486	$1,072,500	$349,213	$1,421,713	$30,218		$1,451,931	$5,222,555	4.60
	Multi-Residential Total		**$6,948,082**	**$0**	**$419,567**	**$7,367,649**	**$1,072,500**	**$349,213**	**$1,421,713**	**$63,968**		**$1,485,681**	**$5,881,968**	**4.96**
LOW INCOME TOTAL			**$9,173,487**	**$0**	**$617,594**	**$9,791,081**	**$1,682,500**	**$492,389**	**$2,174,889**	**$158,252**		**$2,333,141**	**$7,457,940**	**4.20**
GENERAL ADMIN														
	General Admin													
		Labour							$0		$2,124,578			
		General Evaluation							$0		$670,551			
		DSM Support							$0		$447,034			
	General Admin Total								**$0**		**$3,242,163**			
GENERAL ADMIN TOTAL									**$0**		**$3,242,163**			
GRAND TOTAL			**$123,804,194**	**$940,825**	**$25,177,590**	**$149,922,608**	**$6,739,324**	**$2,260,678**	**$9,000,002**	**$29,394,283**	**$3,242,163**	**$38,394,285**	**$111,528,324**	
												Less General Adminstration:	**-$3,242,163**	
												TOTAL NET BENEFITS @ ZERO EMISSIONS:	**$108,286,161**	

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

Table 2

Total Resource Cost Test Screening of Measures

Note:
Measures are listed in the same order as the Table of Measure Assumptions (Exhibit B, Tab 2, Schedule 4)
Shaded cells indicate measures applicable to Union Gas only

	New / Existing	Measure	TRC Benefits				TRC Costs			NET TRC Benefits	TRC Ratio
			NPV Gas	NPV Electric	NPV Water	Total TRC Benefits	Total Incremental costs	Net Incremen-tal costs	Total TRC Costs		
Residential Space Heating		**Efficient Equipment**									
1	Existing	Attic Insulation	$ -	$ -	$ -	$ -		-	$ -	$ -	
2	Existing	Basement Wall Insulation	$ -	$ -	$ -	$ -		-	$ -	$ -	
3	Existing	Draft Proofing Kit	$ -	$ -	$ -	$ -		-	$ -	$ -	
4	New	Energy Star Home	$ 3,145	$ 1,880	$ -	$ 5,025	$ 3,200.00	3,200	$ 3,200	$ 1,825	1.57
5	Existing	Fireplace intermittent ignition control retrofit	$ -	$ -	$ -	$ -		-	$ -	$ -	
6	Existing	High Efficiency Condensing Furnace	$ 332	$ -	$ -	$ 332	$ 1,767.00	1,767	$ 1,767	$ (1,435)	**0.19**
7	New	High Efficiency Fireplace with Pilotless Ignition	$ 301	$ (35)	$ -	$ 266	$ 135.00	135	$ 135	$ 131	1.97
8	New	High Efficiency Fireplace with Pilotless Ignition	$ 298	$ (35)	$ -	$ 263	$ 135.00	135	$ 135	$ 128	1.95
9	New	High Efficiency Fireplace with Pilotless Ignition	$ 334	$ (35)	$ -	$ 299	$ 135.00	135	$ 135	$ 164	2.21
10	New	High Efficiency Fireplace with Pilotless Ignition	$ 296	$ (35)	$ -	$ 260	$ 135.00	135	$ 135	$ 125	1.93
11	Existing	High Efficiency Fireplace with Pilotless Ignition	$ 301	$ (35)	$ -	$ 266	$ 135.00	135	$ 135	$ 131	1.97
12	Existing	High Efficiency Fireplace with Pilotless Ignition	$ 298	$ (35)	$ -	$ 263	$ 135.00	135	$ 135	$ 128	1.95
13	Existing	High Efficiency Fireplace with Pilotless Ignition	$ 334	$ (35)	$ -	$ 299	$ 135.00	135	$ 135	$ 164	2.21
14	Existing	High Efficiency Fireplace with Pilotless Ignition	$ 296	$ (35)	$ -	$ 260	$ 135.00	135	$ 135	$ 125	1.93
15	New	Programmable Thermostat	$ -	$ -	$ -	$ -		-	$ -	$ -	
16	Existing	Programmable Thermostat	$ -	$ -	$ -	$ -		-	$ -	$ -	
17	New	Programmable Thermostat	$ 121	$ 51	$ -	$ 173	$ 53.22	53	$ 53	$ 119	3.24
18	Existing	Programmable Thermostat	$ 121	$ 51	$ -	$ 173	$ 50.00	50	$ 50	$ 123	3.45
19	Existing	Reflector Panels	$ -	$ -	$ -	$ -		-	$ -	$ -	
20	Existing	Reflector Panels	$ 368	$ -	$ -	$ 368	$ 238.00	238	$ 238	$ 130	1.54
Residential Water Heating											
1	New	Faucet Aerator	$ 19	$ -	$ 58	$ 78	$ 2.72	2	$ 2	$ 76	41.44
2	New	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
3	Existing	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
4	Existing	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
5	New/Existing	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
6	New	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
7	Existing	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
8	Existing	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
9	New	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
10	New	Faucet Aerator (Distributed)	$ 11	$ -	$ 33	$ 44	$ 0.55	0	$ 0	$ 44	116.27
11	Existing	Faucet Aerator (Distributed)	$ 11	$ -	$ 33	$ 44	$ 0.55	0.38	$ 0	$ 44	116.27
12	Existing	Faucet Aerator (Distributed)	$ 6	$ -	$ 19	$ 26	$ 1.00	1	$ 1	$ 25	37.57
13	New	Faucet Aerator (Distributed)	$ 35	$ -	$ 103	$ 138	$ 1.00	1	$ 1	$ 137	199.56
14	Existing	Faucet Aerator (Distributed)	$ 38	$ -	$ 113	$ 151	$ 1.00	1	$ 1	$ 151	219.20
15	New	Faucet Aerator (Distributed)	$ 25	$ -	$ 76	$ 100	$ 1.65	1	$ 1	$ 99	88.26
16	Existing	Faucet Aerator (Distributed)	$ 25	$ -	$ 76	$ 100	$ 1.00	1	$ 1	$ 100	145.63
17	New	Low-flow showerhead	$ 68	$ -	$ 182	$ 250	$ 16.76	15	$ 15	$ 235	16.56
18	Existing	Low-flow showerhead	$ -	$ -	$ -	$ -		-	$ -	$ -	
19	New	Low-flow showerhead	$ 75	$ -	$ 218	$ 292	$ 4.26	4	$ 4	$ 288	76.20
20	New	Low-flow showerhead	$ 61	$ -	$ 147	$ 207	$ 12.50	11	$ 11	$ 196	18.43
21	Existing	Low-flow showerhead (Contractor Installed)	$ -	$ -	$ -	$ -		-	$ -	$ -	

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	New / Existing	Measure	TRC Benefits: NPV Gas	TRC Benefits: NPV Electric	TRC Benefits: NPV Water	TRC Benefits: Total TRC Benefits	TRC Costs: Total Incremental costs	TRC Costs: Net Incremental costs	TRC Costs: Total TRC Costs	NET TRC Benefits	TRC Ratio
22	Existing	Low-flow showerhead (Contractor Installed)	$ -	$ -	$ -	$ -		-	$ -	$ -	
23	Existing	Low-flow showerhead (Distributed)	$ 115	$ -	$ 296	$ 411	$ 4.26	4	$ 4	$ 407	107.27
24	Existing	Low-flow showerhead (Distributed)	$ 70	$ -	$ 210	$ 281	$ 4.26	4	$ 4	$ 277	73.26
25	New/Existing	Low-flow showerhead (Distributed)	$ -	$ -	$ -	$ -		-	$ -	$ -	
26	Existing	Low-flow showerhead (Installed)	$ 70	$ -	$ 210	$ 281	$ 19.00	17	$ 17	$ 264	16.43
27	Existing	Low-flow showerhead (Installed)	$ 115	$ -	$ 296	$ 411	$ 19.00	17	$ 17	$ 394	24.05
28	Existing	Pipe Insulation	$ 27	$ -	$ -	$ 27	$ 2.00	2	$ 2	$ 25	14.08
29	Existing	Pipe Wrap (R-4)	$ -	$ -	$ -	$ -		-	$ -	$ -	
30	Existing	Solar Pool Heaters	$ 2,719	$ (64)	$ -	$ 2,655	$ 1,450.00	1,421	$ 1,421	$ 1,234	1.87
31	New/Existing	Tankless Water Heater	$ -	$ -	$ -	$ -		-	$ -	$ -	
32	Existing	Tankless Water Heater	$ 297	$ -	$ -	$ 297	$ 750.00	735	$ 735	$ (438)	**0.40**

Low Income Space Heating

1	Existing	Early Furnace Replacement - 60% AFUE	$ -	$ -	$ -	$ -		-	$ -	$ -	
2	Existing	Early Furnace Replacement - 70% AFUE	$ -	$ -	$ -	$ -		-	$ -	$ -	
3	Existing	Programmable Thermostat	$ -	$ -	$ -	$ -		-	$ -	$ -	
4	Existing	Programmable Thermostat	$ 120	$ 51	$ -	$ 171	$ 69.18	68	$ 68	$ 102	2.49

Low Income Water Heating

1	Existing	Early Hot Water Heater Replacement (0.575 to 0.62 EF)	$ -	$ -	$ -	$ -		-	$ -	$ -	
2	Existing	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
3	Existing	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
4	Existing	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
5	Existing	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
6	Existing	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
7	Existing	Faucet Aerator	$ 15	$ -	$ 48	$ 63	$ 0.55	1	$ 1	$ 63	116.27
8	Existing	Faucet Aerator	$ 9	$ -	$ 28	$ 37	$ 0.46	0	$ 0	$ 37	81.67
9	Existing	Faucet Aerator	$ 54	$ -	$ 163	$ 217	$ 1.00	1	$ 1	$ 216	219.20
10	Existing	Faucet Aerator	$ 36	$ -	$ 109	$ 144	$ 0.94	1	$ 1	$ 143	154.92
11	Existing	Low-flow showerhead	$ 74	$ -	$ 222	$ 296	$ 18.71	18	$ 18	$ 279	16.68
12	Existing	Low-flow showerhead	$ 122	$ -	$ 312	$ 434	$ 18.71	18	$ 18	$ 416	24.42
13	Existing	Low-flow showerhead (Contractor installed)	$ -	$ -	$ -	$ -		-	$ -	$ -	
14	Existing	Low-flow showerhead (Contractor installed)	$ -	$ -	$ -	$ -		-	$ -	$ -	
15	Existing	Pipe insulation for DHW outlet pipe	$ -	$ -	$ -	$ -		-	$ -	$ -	

Commercial Cooking

1	New/Existing	Energy Star Fryer	$ 1,702	$ 11	$ -	$ 1,713	$ 1,028.00	822	$ 822	$ 891	2.08
2	New/Existing	Energy Star Convection Ovens - Full Size	$ 1,331	$ 1	$ -	$ 1,332	$ 875.00	700	$ 700	$ 632	1.90
3	New/Existing	Energy Star Steam Cookers	$ 4,439	$ 91	$ 482	$ 5,012	$ 2,000.00	1,600	$ 1,600	$ 3,412	3.13
4	New/Existing	High Efficiency Under-Fired Broilers	$ 2,636	$ -	$ -	$ 2,636	$ 1,270.00	1,016	$ 1,016	$ 1,620	2.59

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Commercial Space Heating											
1	Existing	Air Curtains	$ 3,326	$ 922	$ -	$ 4,247	$ 2,500.00	2,375	$ 2,375	$ 1,872	1.79
2	New/Existing	Air Curtains	$ 44,820	$ 843	$ -	$ 45,664	$ 10,170.00	9,662	$ 9,662	$ 36,002	4.73
3	New/Existing	Air Curtains	$ 20,571	$ (4,702)	$ -	$ 15,869	$ 8,242.00	7,830	$ 7,830	$ 8,039	2.03
4	New/Existing	Air Curtains	$ 16,456	$ (4,846)	$ -	$ 11,609	$ 8,242.00	7,830	$ 7,830	$ 3,779	1.48
5	Existing	Air Curtains	$ 1,451	$ 155	$ -	$ 1,606	$ 1,650.00	1,568	$ 1,568	$ 38	1.02
6	New	Condensing Boiler - Space (Under 300 MBH, 90% or greater AFUE)	$ 4,755	$ -	$ -	$ 4,755	$ 2,414.00	2,293	$ 2,293	$ 2,462	2.07
7	Existing	Condensing Boiler - Space (Under 300 MBH, 90% or greater AFUE)	$ 4,755	$ -	$ -	$ 4,755	$ 2,984.00	2,835	$ 2,835	$ 1,920	1.68
8	New/Existing	Condensing Boilers - Space Heating, 300 and above MBTUH	$ -	$ -	$ -	$ -		-	$ -	$ -	
9	New/Existing	Condensing Make Up Air Unit - MR and LTC	$ 13,573	$ -	$ -	$ 13,573	$ 6,252.00	5,939	$ 5,939	$ 7,634	2.29
10	New/Existing	Condensing Make Up Air Unit - Retail and Comm	$ 10,833	$ -	$ -	$ 10,833	$ 6,252.00	5,939	$ 5,939	$ 4,893	1.82
11	New/Existing	Condensing Unit Heater	$ 1,622	$ (199)	$ -	$ 1,423	$ 1,290.00	1,290	$ 1,290	$ 133	1.10
12	New/Existing	Demand Control Kitchen Ventilation	$ 10,443	$ 12,180	$ -	$ 22,623	$ 10,000.00	9,500	$ 9,500	$ 13,123	2.38
13	New/Existing	Demand Control Kitchen Ventilation	$ 41,164	$ 44,231	$ -	$ 85,394	$ 20,000.00	19,000	$ 19,000	$ 66,394	4.49
14	New/Existing	Demand Control Kitchen Ventilation	$ 24,985	$ 27,835	$ -	$ 52,820	$ 15,000.00	14,250	$ 14,250	$ 38,570	3.71
15	New/Existing	Destratification Fans	$ 20,607	$ (58)	$ -	$ 20,549	$ 7,021.00	6,319	$ 6,319	$ 14,230	3.25
16	New	Energy Recovery Ventilation (Multi-Family, Health Care, Nursing Home)	$ 28,946	$ -	$ -	$ 28,946	$ 7,679.70	7,296	$ 7,296	$ 21,650	3.97
17	Existing	Energy Recovery Ventilation (Multi-Family, Health Care, Nursing Home)	$ 30,702	$ -	$ -	$ 30,702	$ 7,679.70	7,296	$ 7,296	$ 23,406	4.21
18	New	Energy Recovery Ventilation (Hotel, Restaurant, Retail)	$ 16,103	$ -	$ -	$ 16,103	$ 7,679.70	7,296	$ 7,296	$ 8,808	2.21
19	Existing	Energy Recovery Ventilation (Hotel, Restaurant, Retail)	$ 17,057	$ -	$ -	$ 17,057	$ 7,679.70	7,296	$ 7,296	$ 9,761	2.34
20	New	Energy Recovery Ventilation (Office, Warehouse, School)	$ 10,284	$ -	$ -	$ 10,284	$ 7,679.70	7,296	$ 7,296	$ 2,988	1.41
21	Existing	Energy Recovery Ventilation (Office, Warehouse, School)	$ 10,886	$ -	$ -	$ 10,886	$ 7,679.70	7,296	$ 7,296	$ 3,590	1.49
22	New	Heat Recovery Ventilation (Multi-Family, Health Care, Nursing Home)	$ 6,268	$ -	$ -	$ 6,268	$ 2,581.15	2,452	$ 2,452	$ 3,816	2.56
23	Existing	Heat Recovery Ventilation (Multi-Family, Health Care, Nursing Home)	$ 6,883	$ -	$ -	$ 6,883	$ 2,581.15	2,452	$ 2,452	$ 4,431	2.81
24	New	Heat Recovery Ventilation (Hotel, Restaurant, Retail)	$ 3,485	$ -	$ -	$ 3,485	$ 2,581.15	2,452	$ 2,452	$ 1,033	1.42
25	Existing	Heat Recovery Ventilation (Hotel, Restaurant, Retail)	$ 3,822	$ -	$ -	$ 3,822	$ 2,581.15	2,452	$ 2,452	$ 1,370	1.56
26	New	Heat Recovery Ventilation (Office, Warehouse, School)	$ 2,226	$ -	$ -	$ 2,226	$ 2,581.15	2,452	$ 2,452	$ (226)	**0.91**
27	Existing	Heat Recovery Ventilation (Office, Warehouse, School)	$ 2,446	$ -	$ -	$ 2,446	$ 2,581.15	2,452	$ 2,452	$ (6)	**1.00**

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	New / Existing	Measure	NPV Gas	NPV Electric	NPV Water	Total TRC Benefits	Total Incremental costs	Net Incremen-tal costs	Total TRC Costs	NET TRC Benefits	TRC Ratio
28	New	High Efficiency Boiler - Space Heating (< 100 Mbtu/h)	$ 1,932	$ -	$ -	$ 1,932	$ 1,238.00	1,176	$ 1,176	$ 756	1.64
29	Existing	High Efficiency Boiler - Space Heating (< 100 Mbtu/h)	$ 1,932	$ -	$ -	$ 1,932	$ 1,808.00	1,718	$ 1,718	$ 215	1.13
30	New	High Efficiency Boiler - Space Heating (100 to 199 Mbtu/h)	$ 2,928	$ -	$ -	$ 2,928	$ 1,544.00	1,467	$ 1,467	$ 1,461	2.00
31	Existing	High Efficiency Boiler - Space Heating (100 to 199 Mbtu/h)	$ 2,928	$ -	$ -	$ 2,928	$ 2,114.00	2,008	$ 2,008	$ 919	1.46
32	New	High Efficiency Boiler - Space Heating (200 to 299 Mbtu/h)	$ 4,880	$ -	$ -	$ 4,880	$ 1,388.00	1,319	$ 1,319	$ 3,561	3.70
33	Existing	High Efficiency Boiler - Space Heating (200 to 299 Mbtu/h)	$ 4,880	$ -	$ -	$ 4,880	$ 1,958.00	1,860	$ 1,860	$ 3,019	2.62
34	Existing	High Efficiency Condensing Furnace	$ 1,082	$ -	$ -	$ 1,082	$ 2,520.00	2,079	$ 2,079	$ (997)	**0.52**
35	New/Existing	Infrared Heaters	$ 729	$ 12	$ -	$ 741	$ 305.00	204	$ 204	$ 537	3.63
36	New/Existing	Infrared Heaters	$ 6,780	$ 668	$ -	$ 7,448	$ 2,836.50	1,900	$ 1,900	$ 5,548	3.92
37	New/Existing	Infrared Heaters	$ 3,135	$ 313	$ -	$ 3,448	$ 1,311.50	879	$ 879	$ 2,569	3.92
38	New	Prescriptive Higher Efficiency Boiler - Space Heating	$ 22,520	$ -	$ -	$ 22,520	$ 5,690.00	5,007	$ 5,007	$ 17,513	4.50
39	Existing	Prescriptive Higher Efficiency Boiler - Space Heating	$ 33,441	$ -	$ -	$ 33,441	$ 7,050.00	6,204	$ 6,204	$ 27,237	5.39
40	New	Prescriptive Higher Efficiency Boiler - Space Heating	$ 22,520	$ -	$ -	$ 22,520	$ 5,690.00	5,007	$ 5,007	$ 17,513	4.50
41	Existing	Prescriptive Higher Efficiency Boiler - Space Heating	$ 33,441	$ -	$ -	$ 33,441	$ 7,050.00	6,204	$ 6,204	$ 27,237	5.39
42	Existing	Prescriptive Schools - Elementary	$ -	$ -	$ -	$ -		-	$ -	$ -	
43	Existing	Prescriptive Schools - Elementary	$ 18,727	$ -	$ -	$ 18,727	$ 8,646.00	7,608	$ 7,608	$ 11,119	2.46
44	Existing	Prescriptive Schools - Secondary	$ -	$ -	$ -	$ -		-	$ -	$ -	
45	Existing	Prescriptive Schools - Secondary	$ 75,842	$ -	$ -	$ 75,842	$ 14,470.00	12,734	$ 12,734	$ 63,108	5.96
46	Existing	Programmable Thermostat	$ -	$ -	$ -	$ -		-	$ -	$ -	
47	Existing	Programmable Thermostat	$ 119	$ 6	$ -	$ 125	$ 110.00	88	$ 88	$ 37	1.42
48	Existing	Programmable Thermostat	$ 106	$ 43	$ -	$ 149	$ 110.00	88	$ 88	$ 61	1.70
49	Existing	Programmable Thermostat	$ 126	$ 58	$ -	$ 185	$ 110.00	88	$ 88	$ 97	2.10
50	Existing	Programmable Thermostat	$ 18	$ 8	$ -	$ 27	$ 110.00	88	$ 88	$ (61)	**0.30**
51	Existing	Programmable Thermostat	$ 18	$ 11	$ -	$ 29	$ 110.00	88	$ 88	$ (59)	**0.33**
52	Existing	Programmable Thermostat	$ 27	$ 10	$ -	$ 37	$ 110.00	88	$ 88	$ (51)	**0.42**
53	Existing	Programmable Thermostat	$ 64	$ 66	$ -	$ 130	$ 110.00	88	$ 88	$ 42	1.48
54	Existing	Programmable Thermostat	$ 40	$ 12	$ -	$ 52	$ 110.00	88	$ 88	$ (36)	**0.60**
55	Existing	Programmable Thermostat	$ 26	$ 14	$ -	$ 40	$ 110.00	88	$ 88	$ (48)	**0.46**
56	Existing	Programmable Thermostat	$ 20	$ 14	$ -	$ 35	$ 110.00	88	$ 88	$ (53)	**0.39**
57	Existing	Programmable Thermostat	$ 71	$ 33	$ -	$ 104	$ 110.00	88	$ 88	$ 16	1.18
58	Existing	Programmable Thermostat	$ 242	$ 7	$ -	$ 249	$ 110.00	88	$ 88	$ 161	2.83
59	New/Existing	Rooftop Unit	$ 555	$ -	$ -	$ 555	$ 375.00	356	$ 356	$ 198	1.56

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	New / Existing	Measure	NPV Gas	NPV Electric	NPV Water	Total TRC Benefits	Total Incremental costs	Net Incremen-tal costs	Total TRC Costs	NET TRC Benefits	TRC Ratio
Commercial Water Heating											
1	New/Existing	Commercial Laundry Washing Equipment with Ozone	$ 6,904	$ 191	$ 3,507	$ 10,602	$ 10,970.00	10,092	$ 10,092	$ 510	1.05
2	New/Existing	Commercial Laundry Washing Equipment with Ozone	$ 18,516	$ 497	$ 9,118	$ 28,131	$ 30,270.00	27,848	$ 27,848	$ 282	1.01
3	New/Existing	Commercial Laundry Washing Equipment with Ozone	$ 32,608	$ 796	$ 12,771	$ 46,175	$ 49,667.00	45,694	$ 45,694	$ 481	1.01
4	New/Existing	Commercial Laundry Washing Equipment with Ozone	$ 105,631	$ 2,519	$ 40,442	$ 148,593	$ 160,065.00	147,260	$ 147,260	$ 1,333	1.01
5	Existing	Condensing Boiler - DHW	$ 8,779	$ -	$ -	$ 8,779	$ 2,984.00	2,835	$ 2,835	$ 5,945	3.10
6	New	Condensing Boiler - DHW	$ 8,779	$ -	$ -	$ 8,779	$ 2,414.00	2,293	$ 2,293	$ 6,486	3.83
7	New/Existing	Condensing Gas Water Heater (1,000gal/day)	$ 2,782	$ -	$ -	$ 2,782	$ 2,230.00	2,119	$ 2,119	$ 664	1.31
8	New/Existing	Condensing Gas Water Heater (100gal/day)	$ 596	$ -	$ -	$ 596	$ 2,230.00	2,119	$ 2,119	$ (1,523)	**0.28**
9	New/Existing	Condensing Gas Water Heater (500gal/day)	$ 1,566	$ -	$ -	$ 1,566	$ 2,230.00	2,119	$ 2,119	$ (552)	**0.74**
10	New	Drain Water Heat Recovery (DWHR)	$ 132,558	$ -	$ -	$ 132,558	$ 37,211.00	35,350	$ 35,350	$ 97,207	3.75
11	New	Drain Water Heat Recovery (DWHR)	$ 1,050	$ -	$ -	$ 1,050	$ 776.00	737	$ 737	$ 313	1.42
12	New	Drain Water Heat Recovery (DWHR)	$ 12	$ -	$ -	$ 12	$ 3.41	3	$ 3	$ 9	3.78
13	New	Drain Water Heat Recovery (DWHR)	$ 32	$ -	$ -	$ 32	$ 11.88	11	$ 11	$ 21	2.83
14	New	Drain Water Heat Recovery (DWHR)	$ 786	$ -	$ -	$ 786	$ 250.00	238	$ 238	$ 549	3.31
15	New	Drain Water Heat Recovery (DWHR)	$ 32	$ -	$ -	$ 32	$ 16.54	16	$ 16	$ 16	2.04
16	Existing	Drain Water Heat Recovery (DWHR)	$ 132,558	$ -	$ -	$ 132,558	$ 40,811.00	38,770	$ 38,770	$ 93,787	3.42
17	Existing	Drain Water Heat Recovery (DWHR)	$ 1,050	$ -	$ -	$ 1,050	$ 1,209.00	1,149	$ 1,149	$ (98)	**0.91**
18	Existing	Drain Water Heat Recovery (DWHR)	$ 31	$ -	$ -	$ 31	$ 6.26	6	$ 6	$ 25	5.20
19	Existing	Drain Water Heat Recovery (DWHR)	$ 83	$ -	$ -	$ 83	$ 18.19	17	$ 17	$ 65	4.78
20	Existing	Drain Water Heat Recovery (DWHR)	$ 786	$ -	$ -	$ 786	$ 274.00	260	$ 260	$ 526	3.02
21	Existing	Drain Water Heat Recovery (DWHR)	$ 83	$ -	$ -	$ 83	$ 25.33	24	$ 24	$ 59	3.43
22	New/Existing	Energy Star Dishwasher*	$ 752	$ 1,584	$ 952	$ 3,287	$ (13.00)	(8)	$ 1	$ 3,286	3287.30
23	New/Existing	Energy Star Dishwasher*	$ 306	$ 236	$ 387	$ 929	$ (13.00)	(8)	$ 1	$ 928	929.03
24	New/Existing	Energy Star Dishwasher*	$ 1,030	$ 2,695	$ 1,322	$ 5,047	$ (350.00)	(280)	$ 1	$ 5,046	5046.89
25	New/Existing	Energy Star Dishwasher*	$ 1,399	$ 649	$ 1,796	$ 3,844	$ (350.00)	(280)	$ 1	$ 3,843	3843.80
26	New/Existing	Energy Star Dishwasher	$ 3,998	$ 8,184	$ 5,176	$ 17,359	$ 2,375.00	1,734	$ 1,734	$ 15,625	10.01
27	New/Existing	Energy Star Dishwasher	$ 6,729	$ 13,198	$ 8,712	$ 28,640	$ 288.00	210	$ 210	$ 28,429	136.22
28	New	High Efficiency Boiler - DHW only (< 100 Mbtu/h)	$ 6,412	$ -	$ -	$ 6,412	$ 1,238.00	1,176	$ 1,176	$ 5,236	5.45
29	Existing	High Efficiency Boiler - DHW only (< 100 Mbtu/h)	$ 3,934	$ -	$ -	$ 3,934	$ 1,808.00	1,718	$ 1,718	$ 2,217	2.29
30	New	High Efficiency Boiler - DHW only (100 to 199 Mbtu/h)	$ 4,458	$ -	$ -	$ 4,458	$ 1,544.00	1,467	$ 1,467	$ 2,991	3.04
31	Existing	High Efficiency Boiler - DHW only (100 to 199 Mbtu/h)	$ 9,715	$ -	$ -	$ 9,715	$ 2,114.00	2,008	$ 2,008	$ 7,707	4.84
32	New	High Efficiency Boiler - DHW only (200 to 299 Mbtu/h)	$ 9,935	$ -	$ -	$ 9,935	$ 1,388.00	1,319	$ 1,319	$ 8,616	7.53
33	Existing	High Efficiency Boiler - DHW only (200 to 299 Mbtu/h)	$ 7,429	$ -	$ -	$ 7,429	$ 1,958.00	1,860	$ 1,860	$ 5,569	3.99

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Shaded cells indicate measures applicable to Union Gas only

			TRC Benefits				TRC Costs				
	New / Existing	Measure	NPV Gas	NPV Electric	NPV Water	Total TRC Benefits	Total Incremental costs	Net Incremen-tal costs	Total TRC Costs	NET TRC Benefits	TRC Ratio
34	Existing	Pre-Rinse Spray Nozzle	$ -	$ -	$ -	$ -		-	$ -	$ -	
35	New	Pre-Rinse Spray Nozzle (Full Service)	$ 1,097	$ -	$ 1,981	$ 3,078	$ 150.00	150	$ 150	$ 2,928	20.52
36	Existing	Pre-Rinse Spray Nozzle (Full Service)	$ 1,097	$ -	$ 1,981	$ 3,078	$ 150.00	150	$ 150	$ 2,928	20.52
37	Existing	Pre-Rinse Spray Nozzle (Full Service)	$ 390	$ -	$ 765	$ 1,155	$ 150.00	150	$ 150	$ 1,005	7.70
38	New	Pre-Rinse Spray Nozzle (Limited)	$ 289	$ -	$ 522	$ 811	$ 150.00	150	$ 150	$ 661	5.41
39	Existing	Pre-Rinse Spray Nozzle (Limited)	$ 289	$ -	$ 522	$ 811	$ 150.00	150	$ 150	$ 661	5.41
40	Existing	Pre-Rinse Spray Nozzle (Limited)	$ 77	$ -	$ 151	$ 228	$ 150.00	150	$ 150	$ 78	1.52
41	New	Pre-Rinse Spray Nozzle (Other)	$ 271	$ -	$ 489	$ 760	$ 150.00	150	$ 150	$ 610	5.07
42	Existing	Pre-Rinse Spray Nozzle (Other)	$ 271	$ -	$ 489	$ 760	$ 150.00	150	$ 150	$ 610	5.07
43	Existing	Pre-Rinse Spray Nozzle (Other)	$ 93	$ -	$ 182	$ 275	$ 150.00	150	$ 150	$ 125	1.83
44	New	Prescriptive Higher Efficiency Boiler - DWH	$ 6,360	$ -	$ -	$ 6,360	$ 5,740.00	5,051	$ 5,051	$ 1,309	1.26
45	New	Prescriptive Higher Efficiency Boiler - DWH	$ 10,066	$ -	$ -	$ 10,066	$ 7,050.00	6,204	$ 6,204	$ 3,862	1.62
46	Existing	Prescriptive Higher Efficiency Boiler - DWH	$ 6,360	$ -	$ -	$ 6,360	$ 5,740.00	5,051	$ 5,051	$ 1,309	1.26
47	Existing	Prescriptive Higher Efficiency Boiler - DWH	$ 10,066	$ -	$ -	$ 10,066	$ 7,050.00	6,204	$ 6,204	$ 3,862	1.62
48	New	Tankless Water Heater	$ 352	$ -	$ -	$ 352	$ (1,102.00)	(1,080)	$ (1,080)	$ 1,432	**-0.33**
49	Existing	Tankless Water Heater	$ 352	$ -	$ -	$ 352	$ (1,102.00)	(1,080)	$ (1,080)	$ 1,432	**-0.33**

Multi-Residential Water Heating

	New / Existing	Measure	NPV Gas	NPV Electric	NPV Water	Total TRC Benefits	Total Incremental costs	Net Incremental costs	Total TRC Costs	NET TRC Benefits	TRC Ratio
1	New/Existing	CEE Tier 2 Front-Loading Clothes Washer	$ 177	$ 270	$ 792	$ 1,238	$ 600.00	540	$ 540	$ 698	2.29
2	New/Existing	Energy Star Front-Loading Clothes Washer	$ -	$ -	$ -	$ -		-	$ -	$ -	
3	Existing	Faucet Aerator	$ 10	$ -	$ 30	$ 40	$ 1.50	1	$ 1	$ 39	29.53
4	Existing	Faucet Aerator	$ 6	$ -	$ 17	$ 23	$ 2.00	2	$ 2	$ 21	12.85
5	Existing	Faucet Aerator	$ 34	$ -	$ 102	$ 136	$ 2.00	2	$ 2	$ 134	75.53
6	New	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
7	Existing	Faucet Aerator	$ 23	$ -	$ 68	$ 91	$ 2.00	2	$ 2	$ 89	50.32
8	New	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
9	Existing	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
10	New	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
11	Existing	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
12	New	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
13	Existing	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
14	Existing	Faucet Aerator	$ -	$ -	$ -	$ -		-	$ -	$ -	
15	New/Existing	Low-Flow Showerhead - (MF ONLY)	$ -	$ -	$ -	$ -		-	$ -	$ -	
16	New	Low-flow showerhead (Distributed)	$ -	$ -	$ -	$ -		-	$ -	$ -	
17	Existing	Low-flow showerhead (Distributed)	$ -	$ -	$ -	$ -		-	$ -	$ -	
18	New	Low-flow showerhead (Distributed)	$ -	$ -	$ -	$ -		-	$ -	$ -	
19	Existing	Low-flow showerhead (Distributed)	$ -	$ -	$ -	$ -		-	$ -	$ -	
20	New	Low-Flow Showerhead (Per household, Installed)	$ 51	$ -	$ 147	$ 197	$ 12.50	11	$ 11	$ 186	17.54
21	New	Low-Flow Showerhead (Per household, Installed)	$ 41	$ -	$ 99	$ 140	$ 12.50	11	$ 11	$ 129	12.42
22	Existing	Low-Flow Showerhead (Per household, Installed)	$ 30	$ -	$ 75	$ 105	$ 12.50	11	$ 11	$ 93	9.30
23	Existing	Low-Flow Showerhead (Per household, Installed)	$ 56	$ -	$ 127	$ 183	$ 12.50	11	$ 11	$ 172	16.30

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

Table 2

Total Resource Cost Test Screening of Measures

Note:

Measures are listed in the same order as the Table of Measure Assumptions (Exhibit B, Tab 2, Schedule 4)

Shaded cells indicate measures applicable to Union Gas only

			TRC Benefits				TRC Costs				
	New / Existing	Measure	NPV Gas	NPV Electric	NPV Water	Total TRC Benefits	Total Incremental costs	Net Incremen-tal costs	Total TRC Costs	NET TRC Benefits	TRC Ratio
24	Existing	Low-Flow Showerhead (Per household, Installed)	$ 82	$ -	$ 172	$ 254	$ 12.50	11	$ 11	$ 243	22.58
25	Existing	Low-Flow Showerhead (Per household, Installed)	$ 97	$ -	$ 199	$ 296	$ 12.50	11	$ 11	$ 285	26.30

* negative incremental costs were assigned a value of $1.00

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

TABLE OF MEASURE ASSUMPTIONS

1. The Assumption Table on the following pages has been prepared jointly by Enbridge Gas Distribution Inc. (“Enbridge”) and Union Gas Limited (“Union”) as a common reference document for natural gas Demand Side Management (“DSM”) measures. A column on the Table indicates whether the measure has been approved by the Ontario Energy Board (the “Board”) for use by Union, by Enbridge or by both utilities.

2. All the measures which Enbridge is submitting have been Board approved.
   With two exceptions, all were approved by the Board in the Enbridge 2011 Update submission (EB-2011-0254). The measure assumptions for both Drain Water Heat Recovery and InfraRed Heaters were updated by Union and approved by the Board in the Union Update submission.

Witnesses: A. Mandyam
J. Ramsay

(Shaded) Indicates a variation from the board approved list of input assumptions

Target Market: Sector	Target Market: New/Existing	Union: Deep Measure	Equipment Details: Efficient Equipment	Equipment Details: Details of Efficient Equipment	Equipment Details: Base Equipment	Equipment Details: Details of Base Equipment	Annual Resource Savings: Natural Gas (m3)	Annual Resource Savings: Electricity (kWh)	Annual Resource Savings: Water (L)	Other: EUL	Other: Incremental Cost ($)	Other: Free Rider (%)	Other: Utility Measure Applies to	Other: Reference
Residential Space Heating														
Residential	Existing	X	Attic Insulation	upgrade to R-40	R-10		105	105	0	20	$580	33%	UG	New Measure added by Union
Residential	Existing	X	Basement Wall Insulation	upgrade to R-12	R-1		261	145	0	25	$1654	33%	UG	New Measure added by Union
Residential	Existing		Draft Proofing Kit	(1) Spray Foam, can (1) Caulk, tube (30 ft) Foam Tape (4) Energy Saver Gasket with 2 child safety inserts	No Draft Proofing Kit		236	27	0	1	$20	55%	UG	New Measure added by Union
Residential	New	X	Energy Star Home	version 3	Home built to OBC 2006		1018	1450	0	25	$3200	48%	EGD	Assumption Updated in Enbridge 2011 update. Free Ridership consistent with 2009 Audit.
Residential	Existing		Fireplace intermittent ignition control retrofit		Natural gas fireplace with a pilot		104	-31	0	8	$150	1%	UG	
Residential	Existing	X	High Efficiency Condensing Furnace	AFUE 96	High-Efficiency Furnace	AFUE 90	129	0	0	18	$1767	0%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	New	X	High Efficiency Fireplace with Pilotless Ignition	Freestanding, Minimum 70% EnerGuide Rating	Freestanding fireplace	65% median efficiency	110	-31	0	20	$135	17%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	New	X	High Efficiency Fireplace with Pilotless Ignition	Insert, Minimum 60% EnerGuide Rating	Insert	55% median efficiency	109	-31	0	20	$135	17%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	New	X	High Efficiency Fireplace with Pilotless Ignition	Zero Clearance, >= 40 kBtu.h =Minimum 60% EnerGuide Rating	Zero Clearance		122	-31	0	20	$135	17%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	New	X	High Efficiency Fireplace with Pilotless Ignition	Zero Clearance, < 40 kBtu.h =Minimum 70% EnerGuide Rating	Zero Clearance		108	-31	0	20	$135	17%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	Existing	X	High Efficiency Fireplace with Pilotless Ignition	Freestanding, Minimum 70% EnerGuide Rating	Freestanding fireplace	65% median efficiency	110	-31	0	20	$135	17%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	Existing	X	High Efficiency Fireplace with Pilotless Ignition	Insert, Minimum 60% EnerGuide Rating	Insert	55% median efficiency	109	-31	0	20	$135	17%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	Existing	X	High Efficiency Fireplace with Pilotless Ignition	Zero Clearance, >= 40 kBtu.h =Minimum 60% EnerGuide Rating	Zero Clearance		122	-31	0	20	$135	17%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	Existing	X	High Efficiency Fireplace with Pilotless Ignition	Zero Clearance, < 40 kBtu.h =Minimum 70% EnerGuide Rating	Zero Clearance		108	-31	0	20	$135	17%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	New		Programmable Thermostat		Standard Thermostat		53	54	0	15	$25	10%	UG	
Residential	Existing		Programmable Thermostat		Standard Thermostat		53	54	0	15	$25	43%	UG	
Residential	New		Programmable Thermostat		Standard Thermostat		53	54	0	15	$53.22	10%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	Existing		Programmable Thermostat		Standard Thermostat		53	54	0	15	$50	43%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	Existing		Reflector Panels		No reflector panels		143	0	0	18	$229	0%	UG	
Residential	Existing		Reflector Panels		Radiant heat w/o reflector panels		143	0	0	18	$238	0%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential Water Heating														
Residential	New		Faucet Aerator	Bathroom, 1.5 GPM, (3) aerators	Average Existing Stock	2.2 GPM	18	0	6012	10	$2.72	31%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	New		Faucet Aerator	Bathroom, 1.0 GPM	Ontario Building Code 2006	2.2 GPM	10	0	3,435	10	$0.59	33%	UG	Costs as per utility program costs, bulk purchase.
Residential	Existing		Faucet Aerator	Bathroom, 1.0 GPM	Average existing stock	2.2 GPM	10	0	3,435	10	$0.59	33%	UG	Costs as per utility program costs, bulk purchase.
Residential	Existing		Faucet Aerator	Bathroom, 1.0 GPM	Replace existing 1.5 GPM	1.5 GPM	4		1,432	10	$0.59	33%	UG	New Measure added by Union
Residential	New/Existing		Faucet Aerator	Bathroom, 1.5 GPM	Average existing stock	2.2 GPM	6	0	2,004	10	$0.49	33%	UG	Costs as per utility program costs, bulk purchase.
Residential	New		Faucet Aerator	Kitchen, 1.0 GPM	Ontario Building Code 2006	2.2 GPM	32	0	10,631	10	$1.59	33%	UG	
Residential	Existing		Faucet Aerator	Kitchen, 1.0 GPM	Average existing stock	2.5 GPM	35	0	11,694	10	$1.59	33%	UG	
Residential	Existing		Faucet Aerator	Kitchen, 1.5 GPM	Average existing stock	2.5 GPM	23	0	7,797	10	$1.29	33%	UG	Costs as per utility program costs, bulk purchase.
Residential	New		Faucet Aerator	Kitchen, 1.5 GPM	Ontario Building Code 2006	2.2 GPM	19	0	6,201	10	$1.29	33%	UG	Costs as per utility program costs, bulk purchase.
Residential	New		Faucet Aerator (Distributed)	Bathroom, 1.0 GPM	Ontario Building Code 2006	2.2 GPM	10	0	3435	10	$0.55	31%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	Existing		Faucet Aerator (Distributed)	Bathroom, 1.0 GPM	Average Existing Stock	2.2 GPM	10	0	3435	10	$0.55	31%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	Existing		Faucet Aerator (Distributed)	Bathroom, 1.5 GPM	Average Existing Stock	2.2 GPM	6	0	2004	10	$1	31%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	New		Faucet Aerator (Distributed)	Kitchen, 1.0 GPM	Ontario Building Code 2006	2.2 GPM	32	0	10631	10	$1	31%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	Existing		Faucet Aerator (Distributed)	Kitchen, 1.0 GPM	Average Existing Stock	2.5 GPM	35	0	11694	10	$1	31%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	New		Faucet Aerator (Distributed)	Kitchen, 1.5 GPM	Average Existing Stock	2.5 GPM	23	0	7797	10	$1.65	31%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	Existing		Faucet Aerator (Distributed)	Kitchen, 1.5 GPM	Average Existing Stock	2.5 GPM	23	0	7797	10	$1	31%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	New		Low-flow showerhead	1.25 & 1.5 GPM (Per Household)	Average Existing Stock	2.5 GPM	48	0	14391	10	$16.76	10%	EGD	Assumption Updated in Enbridge 2011 update
Residential	Existing		Low-flow showerhead	1.25 GPM	Replace existing 2.0 GPM	2.0 GPM	33		11,584	10	$3.79	10%	UG	as per Union Filing June 15, 2011 (EB-2011-0225), with updated utility costs
Residential	New		Low-flow showerhead	1.25 GPM (Per household)	Average Existing Stock	2.5 GPM	53	0	17187	10	$4.26	10%	EGD	Assumption Updated in Enbridge 2011 update
Residential	New		Low-flow showerhead	1.5 GPM (Per Household)	Average Existing Stock	2.5 GPM	43	0	11596	10	$12.5	10%	EGD	Assumption Updated in Enbridge 2011 update
Residential	Existing		Low-flow showerhead (Contractor Installed)	1.25 GPM	2.0 -2.5 GPM Showerhead	2.25 GPM	46	0	14294	10	$3.79	10%	UG	Costs as per utility program costs, bulk purchase.
Residential	Existing		Low-flow showerhead (Contractor Installed)	1.25 GPM	2.6 + GPM Showerhead	3.0 GPM	88	0	22580	10	$3.79	10%	UG	Costs as per utility program costs, bulk purchase.
Residential	Existing		Low-flow showerhead (Distributed)	1.25 GPM	2.6 + GPM Showerhead	3.07 GPM	82	0	23374	10	$4.26	10%	EGD	Assumption Updated in Enbridge 2011 update
Residential	Existing		Low-flow showerhead (Distributed)	1.25 GPM	2.0 -2.5 GPM Showerhead	2.45 GPM	50	0	16631	10	$4.26	10%	EGD	Assumption Updated in Enbridge 2011 update
Residential	New/Existing		Low-flow showerhead (Distributed)	1.25 GPM	Average existing stock	2.2 GPM	44	0	13,885	10	$3.79	10%	UG	Costs as per utility program costs, bulk purchase.
Residential	Existing		Low-flow showerhead (Installed)	1.25 GPM	2.0 -2.5 GPM Showerhead	2.45 GPM	50	0	16631	10	$19	10%	EGD	Assumption Updated in Enbridge 2011 update
Residential	Existing		Low-flow showerhead (Installed)	1.25 GPM	2.6 + GPM Showerhead	3.07 GPM	82	0	23374	10	$19	10%	EGD	Assumption Updated in Enbridge 2011 update
Residential	Existing		Pipe Insulation		Water Heater w/o pipe insulation		18	0	0	10	$2/$4	4%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Residential	Existing		Pipe Wrap (R-4)	Insulation for DWH outlet pipe	Uninsulated DHW outlet pipes	R-1	18	0	0	10	$0.98	4%	UG	Costs as per utility program costs, bulk purchase.
Residential	Existing	X	Solar Pool Heaters		Natural gas pool heater		1,116	-57	0	20	$1,450	10%	Both	
Residential	New/Existing	X	Tankless Water Heater	EF 0.82	Storage Tank Water Heater		142	0	0	18	$750	2%	UG	New Measure added by Union
Residential	Existing	X	Tankless Water Heater		Storage Tank Water Heater		130	0	0	18	$750	2%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)

Indicates a variation from the board approved list of input assumptions

Target Market		Union	Equipment Details				Annual Resource Savings			Other				
Sector	New/Existing	Deep Measure	Efficient Equipment	Details of Efficient Equipment	Base Equipment	Details of Base Equipment	Natural Gas (m3)	Electricity (kWh)	Water (L)	EUL	Incremental Cost ($)	Free Rider (%)	Utility Measure Applies to	Reference
Low-Income Space Heating														
Low-Income	Existing	X	Early Furnace Replacement - 60% AFUE	90% AFUE Furnace	60% AFUE Furnace		781			3	$518	0%	UG	New Measure added by Union
Low-Income	Existing	X	Early Furnace Replacement - 70% AFUE	90% AFUE Furnace	70% AFUE Furnace		466			3	$518	0%	UG	New Measure added by Union
Low-Income	Existing		Programmable Thermostat		Standard manual thermostat		53	54	0	15	$26.95	1%	UG	Costs as per utility program costs, bulk purchase.
Low Income	Existing		Programmable Thermostat		Standard Thermostat		53	54	0	15	$69.18	1%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Low Income Water Heating														
Low-Income	Existing	X	Early Hot Water Heater Replacement (0.575 to 0.62 EF)	0.62 EF Water Heater	0.575 EF Water Heater		80			3	$168.00	0%	UG	New Measure added by Union
Low-Income	Existing		Faucet Aerator	Bathroom, 1.0 GPM	Average existing stock	2.2 GPM	10	0	3,435	10	$0.59	1%	UG	Costs as per utility program costs, bulk purchase.
Low-Income	Existing		Faucet Aerator	Bathroom, 1.0 GPM	Replace existing 1.5 GPM	1.5 GPM	4	0	1,432	11	$0.59	1%	UG	New Measure added by Union
Low-Income	Existing		Faucet Aerator	Bathroom, 1.5 GPM	Average existing stock	2.2 GPM	6	0	2,004	10	$0.49	1%	UG	Costs as per utility program costs, bulk purchase.
Low-Income	Existing		Faucet Aerator	Kitchen, 1.0 GPM	Average existing stock	2.5 GPM	35	0	11,694	10	$1.59	1%	UG	Costs as per utility program costs, bulk purchase.
Low-Income	Existing		Faucet Aerator	Kitchen, 1.5 GPM	Average existing stock	2.5 GPM	23	0	7,797	10	$1.29	1%	UG	Costs as per utility program costs, bulk purchase.
Low Income	Existing		Faucet Aerator	Bathroom, 1.0 GPM	Average Existing Stock	2.2 GPM	10	0	3435	10	$0.55	1%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Low Income	Existing		Faucet Aerator	Bathroom, 1.5 GPM	Average Existing Stock	2.2 GPM	6	0	2004	10	$0.46	1%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Low Income	Existing		Faucet Aerator	Kitchen, 1.0 GPM	Average Existing Stock	2.5 GPM	35	0	11694	10	$1	1%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Low Income	Existing		Faucet Aerator	Kitchen, 1.5 GPM	Average Existing Stock	2.5 GPM	23	0	7797	10	$0.94	1%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Low Income	Existing		Low-flow showerhead	1.25 GPM (Installed)	2.0 -2.5 GPM Showerhead	2.45 GPM	50	0	16631	10	$18.71	5%	EGD	Assumption Updated in Enbridge 2011 update
Low Income	Existing		Low-flow showerhead	1.25 GPM (Installed)	2.6 + GPM Showerhead	3.07 GPM	82	0	23374	10	$18.71	5%	EGD	Assumption Updated in Enbridge 2011 update
Low-Income	Existing		Low-flow showerhead (Contractor installed)	1.25 GPM	Average existing stock	2.25 GPM	46	0	14,294	10	$3.79	1%	UG	Costs as per utility program costs, bulk purchase.
Low-Income	Existing		Low-flow showerhead (Contractor installed)	1.25 GPM	Average existing stock	3.0 GPM	88	0	22,580	10	$3.79	1%	UG	Costs as per utility program costs, bulk purchase.
Low-Income	Existing		Pipe insulation for DHW outlet pipe	R-4 insulation	Uninsulated DHW outlet pipes (R-1)	R-1	18	0	0	10	$0.98	1%	UG	
Commercial Cooking														
Commercial	New/Existing	X	Energy Star Fryer	Energy Star	Standard fryer		1083	17	0	12	$1,028	20%	Both	Enbridge Updated Assumption to match approved values from Union Gas's EAC.
Commercial	New/Existing	X	Energy Star Convection Ovens - Full Size	Energy Star	Standard Convection Oven		847	1		12	$875	20%	Both	Measure added by Enbridge in EGD's 2011 update
Commercial	New/Existing	X	Energy Star Steam Cookers	Energy Star	Standard Efficiency Steam Cooker		3224	162	42812	10	$2,000.00	20%	Both	Measure added by Enbridge in EGD's 2011 update
Commercial	New/Existing	X	High Efficiency Under-Fired Broilers		Standard Efficiency Broiler		1677			12	$1,270	20%	Both	Measure added by Enbridge in EGD's 2011 update
Commercial Space Heating														
Commercial	Existing	X	Air Curtains	Double door	Non-air curtain doors		1,529	1,023	0	15	$2,500	5%	Both	
Commercial	New/Existing	X	Air Curtains	Shipping and Receiving Doors (10 x 10)	Non-air curtain doors		20605	-936		15	$10,170	5%	Both	New Measure added by Enbridge in EGD's 2011 update
Commercial	New/Existing	X	Air Curtains	Shipping and Receiving Doors (8 x 10)	Non-air curtain doors		9457	-5220		15	$8,242	5%	Both	New Measure added by Enbridge in EGD's 2011 update
Commercial	New/Existing	X	Air Curtains	Shipping and Receiving Doors (8 x 8)	Non-air curtain doors		7565	-5380		15	$8,242	5%	Both	New Measure added by Enbridge in EGD's 2011 update
Commercial	Existing	X	Air Curtains	Single door	Non-air curtain doors		667	172	0	15	$1,650	5%	Both	
Commercial	New	X	Condensing Boiler - Space (Under 300 MBH, 90% or greater AFUE)		Non-condensing Boiler	80% AFUE	.0108 m3/(Btu/hr)		0	25	<100 MBH = $1,475, 100-199 MBH = $2,414, 200-299 MBH = $3,227	5%	Both	New Measure added by Enbridge in EGD's 2011 update
Commercial	Existing	X	Condensing Boiler - Space (Under 300 MBH, 90% or greater AFUE)		Non-condensing Boiler	80% AFUE	.0108 m3/(Btu/hr)			25	<100 MBH = $2,045, 100-199 MBH = $2,984, 200-299 MBH = $3,797	5%	Both	New Measure added by Enbridge in EGD's 2011 update
Commercial	New/Existing	X	Condensing Boilers - Space Heating, 300 and above MBTUH	88% seasonal efficiency	Non-condensing boiler	76% estimated seasonal efficiency	0.0104 m3/ Btu/hr	0	0	25	$12/Kbtu/hr	5%	UG	Minimum boiler capacity added
Commercial	New/Existing	X	Condensing Make Up Air Unit - MR and LTC		Conventional MUA with constant speed drive		.84 m3/cfm - 2.92 m3/cfm	(0-1.48) kwh/cfm		15	$870 + (.66 - 1.02) per cfm	5%	Both	New Measure added by Enbridge in EGD's 2011 update
Commercial	New/Existing	X	Condensing Make Up Air Unit - Retail and Comm		Conventional MUA with constant speed drive		.41 m3/cfm - 2.07 m3/cfm	(0- .48) kwh/cfm		15	$870 + (.66 - 1.02) per cfm	5%	Both	New Measure added by Enbridge in EGD's 2011 update
Commercial	New/Existing	X	Condensing Unit Heater		% Sales Weighted Average model	78% Annually Efficient	0.00631 m3/Btu/hr	(-)0.00186 kwh/Btu/hr	0	18	$0.0129 /Btu/hr	0%	Both	
Commercial	New/Existing	X	Demand Control Kitchen Ventilation	0 - 4,999 CFM	Kitchen ventilation without DCKV		4,801	13,521	0	15	$10,000	5%	Both	
Commercial	New/Existing	X	Demand Control Kitchen Ventilation	10,000 - 15,000 CFM	Kitchen ventilation without DCKV		18,924	49,102	0	15	$20,000	5%	Both	
Commercial	New/Existing	X	Demand Control Kitchen Ventilation	5,000 - 9,999 CFM	Kitchen ventilation without DCKV		11,486	30,901	0	15	$15,000	5%	Both	
Commercial	New/Existing	X	Destratification Fans		No destratification fans		0.5 m3/ft^2	(-)0.0034 kwh/ft^2	0	15	$7,021	10%	Both	
Commercial	New	X	Energy Recovery Ventilation (Multi-Family, Health Care, Nursing Home)	Ventilation with ERV	Ventilation without ERV		5.77 m3/CFM	0	0	14	$3.18/CFM	5%	Both	Enbridge Updated Assumption & Enbridge's 2011 Update to match approved values from Union Gas's EAC.
Commercial	Existing	X	Energy Recovery Ventilation (Multi-Family, Health Care, Nursing Home)	Ventilation with ERV	Ventilation without ERV		6.12 m3/CFM	0	0	14	$3.18/CFM	5%	Both	Enbridge Updated Assumption & Enbridge's 2011 Update to match approved values from Union Gas's EAC.

Witnesses: A. Mandyam
J. Ramsay

Indicates a variation from the board approved list of input assumptions

Target Market		Union	Equipment Details				Annual Resource Savings			Other				
Sector	New/Existing	Deep Measure	Efficient Equipment	Details of Efficient Equipment	Base Equipment	Details of Base Equipment	Natural Gas (m3)	Electricity (kWh)	Water (L)	EUL	Incremental Cost ($)	Free Rider (%)	Utility Measure Applies to	Reference
Commercial	New	X	Energy Recovery Ventilation (Hotel, Restaurant, Retail)	Ventilation with ERV	Ventilation without ERV		3.21 m3/CFM	0	0	14	$3.18/CFM	5%	Both	Enbridge Updated Assumption & Enbridge's 2011 Update to match approved values from Union Gas's EAC.
Commercial	Existing	X	Energy Recovery Ventilation (Hotel, Restaurant, Retail)	Ventilation with ERV	Ventilation without ERV		3.4 m3/CFM	0	0	14	$3.18/CFM	5%	Both	Enbridge Updated Assumption & Enbridge's 2011 Update to match approved values from Union Gas's EAC.
Commercial	New	X	Energy Recovery Ventilation (Office, Warehouse, School)	Ventilation with ERV	Ventilation without ERV		2.05 m3/CFM	0	0	14	$3.18/CFM	5%	Both	Enbridge Updated Assumption & Enbridge's 2011 Update to match approved values from Union Gas's EAC.
Commercial	Existing	X	Energy Recovery Ventilation (Office, Warehouse, School)	Ventilation with ERV	Ventilation without ERV		2.17 m3/CFM	0	0	14	$3.18/CFM	5%	Both	Enbridge Updated Assumption & Enbridge's 2011 Update to match approved values from Union Gas's EAC.
Commercial	New	X	Heat Recovery Ventilation (Multi-Family, Health Care, Nursing Home)	Ventilation with HRV	Ventilation without HRV		4.28 m3/CFM	0	0	14	$3.61/CFM	5%	Both	Enbridge Updated Assumption & Enbridge's 2011 Update to match approved values from Union Gas's EAC.
Commercial	Existing	X	Heat Recovery Ventilation (Multi-Family, Health Care, Nursing Home)	Ventilation with HRV	Ventilation without HRV		4.70 m3/CFM	0	0	14	$3.61/CFM	5%	Both	Enbridge Updated Assumption & Enbridge's 2011 Update to match approved values from Union Gas's EAC.
Commercial	New	X	Heat Recovery Ventilation (Hotel, Restaurant, Retail)	Ventilation with HRV	Ventilation without HRV		2.38 m3/CFM	0	0	14	$3.61/CFM	5%	Both	Enbridge Updated Assumption & Enbridge's 2011 Update to match approved values from Union Gas's EAC.
Commercial	Existing	X	Heat Recovery Ventilation (Hotel, Restaurant, Retail)	Ventilation with HRV	Ventilation without HRV		2.61 m3/CFM	0	0	14	$3.61/CFM	5%	Both	Enbridge Updated Assumption & Enbridge's 2011 Update to match approved values from Union Gas's EAC.
Commercial	New	X	Heat Recovery Ventilation (Office, Warehouse, School)	Ventilation with HRV	Ventilation without HRV		1.52 m3/CFM	0	0	14	$3.61/CFM	5%	Both	Enbridge Updated Assumption & Enbridge's 2011 Update to match approved values from Union Gas's EAC.
Commercial	Existing	X	Heat Recovery Ventilation (Office, Warehouse, School)	Ventilation with HRV	Ventilation without HRV		1.67 m3/CFM	0	0	14	$3.61/CFM	5%	Both	Enbridge Updated Assumption & Enbridge's 2011 Update to match approved values from Union Gas's EAC.
Commercial	New	X	High Efficiency Boiler - Space Heating (< 100 Mbtu/h)		Non-condensing Boiler, 80% AFUE		.00665 m3/(Btu/hr)	0	0	25	$1,238.00	5%	Both	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Commercial	Existing	X	High Efficiency Boiler - Space Heating (< 100 Mbtu/h)		Non-condensing Boiler, 80% AFUE		.00665 m3/(Btu/hr)	0	0	25	$1,808.00	5%	Both	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Commercial	New	X	High Efficiency Boiler - Space Heating (100 to 199 Mbtu/h)		Non-condensing Boiler, 80% AFUE		.00665 m3/(Btu/hr)	0	0	25	$1,544.00	5%	Both	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Commercial	Existing	X	High Efficiency Boiler - Space Heating (100 to 199 Mbtu/h)		Non-condensing Boiler, 80% AFUE		.00665 m3/(Btu/hr)	0	0	25	$2,114.00	5%	Both	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Commercial	New	X	High Efficiency Boiler - Space Heating (200 to 299 Mbtu/h)		Non-condensing Boiler, 80% AFUE		.00665 m3/(Btu/hr)	0	0	25	$1,388.00	5%	Both	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Commercial	Existing	X	High Efficiency Boiler - Space Heating (200 to 299 Mbtu/h)		Non-condensing Boiler, 80% AFUE		.00665 m3/(Btu/hr)	0	0	25	$1,958.00	5%	Both	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Commercial	Existing	X	High Efficiency Condensing Furnace	96% AFUE	AFUE 90%		1.7/kBtu/hr	0	0	18	$8.4/kBtu/hr	17.5%	Both	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Commercial	New/Existing	X	Infrared Heaters	0 - 49,999 BTU/hr	Regular Unit Heater		0.0159 /Btu/hr	16	0	20	$0.0122 /BTUh	33%	Both	Assumption Updated in Union 2010 audit results
Commercial	New/Existing	X	Infrared Heaters	165,000 - 300,000 BTU/hr	Regular Unit Heater		0.0159 /Btu/hr	873	0	20	$0.0122 /BTUh	33%	Both	Assumption Updated in Union 2010 audit results
Commercial	New/Existing	X	Infrared Heaters	50,000 - 164,999 BTU/hr	Regular Unit Heater		0.0159 /Btu/hr	409	0	20	$0.0122 /BTUh	33%	Both	Assumption Updated in Union 2010 audit results
Commercial	New	X	Prescriptive Higher Efficiency Boiler - Space Heating	83-84% Efficient, 300-2000 MBH	Space Heating Boiler	80% Combustion Efficiency	2,105-16,452	0	0	25	$3900-$4950	10/12/20%	Both	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Commercial	Existing	X	Prescriptive Higher Efficiency Boiler - Space Heating	83-84% Efficient, 300-2000 MBH	Space Heating Boiler	80% Combustion Efficiency	2,105-16,452	0	0	25	$3900-$4950	10/12/20%	Both	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Commercial	New	X	Prescriptive Higher Efficiency Boiler - Space Heating	85-88% Efficient, 300-2000 MBH	Space Heating Boiler	80% Combustion Efficiency	3,125-24,431	0	0	25	$4500-$7050	10/12/20%	Both	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Commercial	Existing	X	Prescriptive Higher Efficiency Boiler - Space Heating	85-88% Efficient, 300-2000 MBH	Space Heating Boiler	80% Combustion Efficiency	3,125-24,431	0	0	25	$4500-$7050	10/12/20%	Both	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Commercial	Existing	X	Prescriptive Schools - Elementary	hydronic boiler with 83%+ efficiency	hydronic boiler with 80%-82% efficiency		10,830	0	0	25	$8,646	27%	UG	
Commercial	Existing	X	Prescriptive Schools - Elementary	hydronic boiler with 83%+ efficiency	Space Heating, Hydronic Boiler	Comb. Eff. Of 80%-82%.	10830	0	0	25	$8,646	12%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Commercial	Existing	X	Prescriptive Schools - Secondary	hydronic boiler with 83%+ efficiency	hydronic boiler with 80%-82% efficiency		43,859	0	0	25	$14,470	27%	UG	
Commercial	Existing	X	Prescriptive Schools - Secondary	hydronic boiler with 83%+ efficiency	Space Heating, Hydronic Boiler	Comb. Eff. Of 80%-82%.	43859	0	0	25	$14,470	12%	EGD	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Commercial	Existing		Programmable Thermostat		Standard thermostat		13 - 108**	15 - 77**	0	15	$110	20%	UG	Costs as per utility program costs, bulk purchase.
Commercial	Existing		Programmable Thermostat	Educational - School	Standard thermostat		65	8	0	15	$110	20%	EGD	Assumption Updated in Enbridge 2011 update.
Commercial	Existing		Programmable Thermostat	Educational - University/College	Standard thermostat		58	57	0	0	$110	20%	EGD	Assumption Updated in Enbridge 2011 update.
Commercial	Existing		Programmable Thermostat	Food Service - Restaurant/Tavern	Standard thermostat		69	77	0	15	$110	20%	EGD	Assumption Updated in Enbridge 2011 update.
Commercial	Existing		Programmable Thermostat	Hotel/Motel	Standard thermostat		10	11	0	0	$110	20%	EGD	Assumption Updated in Enbridge 2011 update.
Commercial	Existing		Programmable Thermostat	Large Hotel	Standard thermostat		10	14	0	0	$110	20%	EGD	Assumption Updated in Enbridge 2011 update.
MultiFamily	Existing		Programmable Thermostat	Multi Family	Standard thermostat		15	13	0	15	$80	20%	Both	Assumption Updated in Enbridge 2011 update.
Commercial	Existing		Programmable Thermostat	Recreation - Small Fitness / Spa	Standard thermostat		35	87	0	15	$110	20%	EGD	Assumption Updated in Enbridge 2011 update.
Commercial	Existing		Programmable Thermostat	Retail - Food	Standard thermostat		22	16	0	15	$110	20%	EGD	Assumption Updated in Enbridge 2011 update.
Commercial	Existing		Programmable Thermostat	Retail - Mall	Standard thermostat		14	19	0	15	$110	20%	EGD	Assumption Updated in Enbridge 2011 update.
Commercial	Existing		Programmable Thermostat	Retail - Strip Mall	Standard thermostat		11	19	0	15	$110	20%	EGD	Assumption Updated in Enbridge 2011 update.
Commercial	Existing		Programmable Thermostat	Small Office	Standard thermostat		39	43	0	0	$110	20%	EGD	Assumption Updated in Enbridge 2011 update.
Commercial	Existing		Programmable Thermostat	Warehouse / Wholesale	Standard thermostat		132	9	0	15	$110	20%	EGD	Assumption Updated in Enbridge 2011 update.
Commercial	New/Existing	X	Rooftop Unit	Two-stage rooftop unit	Single stage rooftop unit		255	0	0	15	$375	5%	Both	

Commercial Water Heating

Commercial	New/Existing	X	Commercial Laundry Washing Equipment with Ozone	Washer extractor – 60 lbs	Commercial Laundry Washing Equipment without Ozone		0.0328 m3/lbs/yr	0.00219 kwh/lbs/yr	2.01 L/lbs/yr	15	$10,970	8%	Both	
Commercial	New/Existing	X	Commercial Laundry Washing Equipment with Ozone	Washer extractor – 500 lbs	Commercial Laundry Washing Equipment without Ozone		0.0328 m3/lbs/yr	0.00219 kwh/lbs/yr	2.01 L/lbs/yr	15	$30,270	8%	Both	
Commercial	New/Existing	X	Commercial Laundry Washing Equipment with Ozone	Tunnel Washer – 120 lbs	Commercial Laundry Washing Equipment without Ozone		0.0240 m3/lbs/yr	0.00152 kwh/lbs/yr	1.22 L/lbs/yr	15	$49,667	8%	Both	
Commercial	New/Existing	X	Commercial Laundry Washing Equipment with Ozone	Tunnel Washer – 500 lbs	Commercial Laundry Washing Equipment without Ozone		0.0240 m3/lbs/yr	0.00152 kwh/lbs/yr	1.22 L/lbs/yr	15	$160,065	8%	Both	

Witnesses: A. Mandyam
J. Ramsay

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Target Market		Union	Equipment Details				Annual Resource Savings			Other				
Sector	New/Existing	Deep Measure	Efficient Equipment	Details of Efficient Equipment	Base Equipment	Details of Base Equipment	Natural Gas (m3)	Electricity (kWh)	Water (L)	EUL	Incremental Cost ($)	Free Rider (%)	Utility Measure Applies to	Reference
Commercial	Existing	X	Condensing Boiler - DHW	Under 300 MBH, 90% or greater AFUE	Non-condensing Boiler	80% AFUE	<100 MBH = .03579, 100-199 MBH = .02196, 200-299 MBH = .01643 m3/(Btu/hr)	0	0	25	<100 MBH = $2,045, 100-199 MBH = $2,984, 200-299 MBH = $3,797	5%	Both	New Measure added by Enbridge in EGD's 2011 update
Commercial	New	X	Condensing Boiler - DHW	Under 300 MBH, 90% or greater AFUE	Non-condensing Boiler	80% AFUE	<100 MBH = .03579, 100-199 MBH = .02196, 200-299 MBH = .01643 m3/(Btu/hr)	0	0	25	<100 MBH = $1,475, 100-199 MBH = $2,414, 200-299 MBH = $3,227	5%	Both	New Measure added by Enbridge in EGD's 2011 update
Commercial	New/Existing	X	Condensing Gas Water Heater (1,000gal/day)	95% thermal efficiency	Conventional storage tank water heater	80% efficiency, 91 gal. tank.	1,551	0	0	13	$2,230	5%	Both	
Commercial	New/Existing	X	Condensing Gas Water Heater (100gal/day)	95% thermal efficiency	Conventional storage tank water heater	80% efficiency, 91gal. tank.	332	0	0	13	$2,230	5%	Both	
Commercial	New/Existing	X	Condensing Gas Water Heater (500gal/day)	95% thermal efficiency	Conventional storage tank water heater	80% efficiency, 91 gal. tank.	873	0	0	13	$2,230	5%	Both	
Commercial	New	X	Drain Water Heat Recovery (DWHR)	Laundromat	No DWHR		49735	0	0	25	$37,211.00	5%	Both	as per Union Filing June 15, 2011 (EB-2011-0225)
Commercial	New	X	Drain Water Heat Recovery (DWHR)	Entertainment, Arena	No DWHR		394 per Showerhead	0	0	25	$776 per Showerhead	5%	Both	as per Union Filing June 15, 2011 (EB-2011-0225)
Commercial	New	X	Drain Water Heat Recovery (DWHR)	University/College Cafeterias - Dishwashing	No DWHR		4.6 per Meal Served/Day	0	0	25	$3.41 per Meal Served/Day	5%	Both	as per Union Filing June 15, 2011 (EB-2011-0225)
Commercial	New	X	Drain Water Heat Recovery (DWHR)	Hospital - Dishwashing	No DWHR		12 per Bed	0	0	25	$11.88 per Bed	5%	Both	as per Union Filing June 15, 2011 (EB-2011-0225)
Commercial	New	X	Drain Water Heat Recovery (DWHR)	Hospital - Laundry	No DWHR		295 Per Bed	0	0	25	$250 per Bed	5%	Both	as per Union Filing June 15, 2011 (EB-2011-0225)
Commercial	New	X	Drain Water Heat Recovery (DWHR)	Nursing Home - Dishwashing	No DWHR		12 per Bed	0	0	25	$16.54 per Bed	5%	Both	as per Union Filing June 15, 2011 (EB-2011-0225)
Commercial	Existing	X	Drain Water Heat Recovery (DWHR)	Laundromat	No DWHR		49735	0	0	25	$40,811.00	5%	Both	as per Union Filing June 15, 2011 (EB-2011-0225)
Commercial	Existing	X	Drain Water Heat Recovery (DWHR)	Entertainment, Arena	No DWHR		394 per Showerhead	0	0	25	$1209 per Showerhead	5%	Both	as per Union Filing June 15, 2011 (EB-2011-0225)
Commercial	Existing	X	Drain Water Heat Recovery (DWHR)	University/College Cafeterias - Dishwashing	No DWHR		11.6 Meal Served per Day	0	0	25	$6.26 per Meal Served per day	5%	Both	as per Union Filing June 15, 2011 (EB-2011-0225)
Commercial	Existing	X	Drain Water Heat Recovery (DWHR)	Hospital - Dishwashing	No DWHR		31 per Bed	0	0	25	$18.19 per Bed	5%	Both	as per Union Filing June 15, 2011 (EB-2011-0225)
Commercial	Existing	X	Drain Water Heat Recovery (DWHR)	Hospital - Laundry	No DWHR		295 per Bed	0	0	25	$274 per Bed	5%	Both	as per Union Filing June 15, 2011 (EB-2011-0225)
Commercial	Existing	X	Drain Water Heat Recovery (DWHR)	Nursing Home - Dishwashing	No DWHR		31 per Bed	0	0	25	$25.33 per Bed	5%	Both	as per Union Filing June 15, 2011 (EB-2011-0225)
Commercial	New/Existing	X	Energy Star Dishwasher	Undercounter – High Temperature	Non-Energy Star Dishwasher		801	3,754	112,795	10	(-)$13	40%	Both	
Commercial	New/Existing	X	Energy Star Dishwasher	Undercounter – Low Temperature	Non-Energy Star Dishwasher		326	559	45,891	10	(-)$13	40%	Both	
Commercial	New/Existing	X	Energy Star Dishwasher	Stationary Rack, (Door type, or Single rack) – High Temperature	Non-Energy Star Dishwasher		619	3,553	87,119	15	(-)$350	20%	Both	
Commercial	New/Existing	X	Energy Star Dishwasher	Stationary Rack, (Door type, or Single rack) – Low Temperature	Non-Energy Star Dishwasher		841	855	118,369	15	(-)$350	20%	Both	
Commercial	New/Existing	X	Energy Star Dishwasher	Rack Conveyor, Single (Tank) – High Temperature	Non-Energy Star Dishwasher		2,203	9,811	310,271	20	$2,375	27%	Both	
Commercial	New/Existing	X	Energy Star Dishwasher	Rack Conveyor, Multi (Tank) – High Temperature	Non-Energy Star Dishwasher		3,708	15,822	522,192	20	$288	27%	Both	
Commercial	New	X	High Efficiency Boiler - DHW only (< 100 Mbtu/h)		Non-Condensing Boiler	80% AFUE	0.0243 m3/(BTU/H)	0	0	25	$1,238.00	5%	Both	New Measure added by Enbridge in EGD's 2011 update
Commercial	Existing	X	High Efficiency Boiler - DHW only (< 100 Mbtu/h)		Non-Condensing Boiler	80% AFUE	0.0243 m3/(BTU/H)	0	0	25	$1,808.00	5%	Both	New Measure added by Enbridge in EGD's 2011 update
Commercial	New	X	High Efficiency Boiler - DHW only (100 to 199 Mbtu/h)		Non-Condensing Boiler	80% AFUE	0.01491 m3/(BTU/H)	0	0	25	$1,544.00	5%	Both	New Measure added by Enbridge in EGD's 2011 update
Commercial	Existing	X	High Efficiency Boiler - DHW only (100 to 199 Mbtu/h)		Non-Condensing Boiler	80% AFUE	0.01491 m3/(BTU/H)	0	0	25	$2,114.00	5%	Both	New Measure added by Enbridge in EGD's 2011 update
Commercial	New	X	High Efficiency Boiler - DHW only (200 to 299 Mbtu/h)		Non-Condensing Boiler	80% AFUE	0.01115 m3/(BTU/H)	0	0	25	$1,388.00	5%	Both	New Measure added by Enbridge in EGD's 2011 update
Commercial	Existing	X	High Efficiency Boiler - DHW only (200 to 299 Mbtu/h)		Non-Condensing Boiler	80% AFUE	0.01115 m3/(BTU/H)	0	0	25	$1,958.00	5%	Both	New Measure added by Enbridge in EGD's 2011 update
Commercial	Existing		Pre-Rinse Spray Nozzle	1.24 GPM	Standard pre-rinse spray nozzle	3.0 GPM	190 - 886**	0	36,484 - 170,326**	5	$60	12.40%	UG	
Commercial	New		Pre-Rinse Spray Nozzle (Full Service)	0.64 GPM	Pre-rinse spray nozzle	3.0 GPM	1286	0	252000	5	$150	0%	EGD	Assumption Updated in Enbridge 2011 update
Commercial	Existing		Pre-Rinse Spray Nozzle (Full Service)	0.64 GPM	Pre-rinse spray nozzle	3.0 GPM	1286	0	252000	5	$150	0%	Both	Assumption Updated in Enbridge 2011 update
Commercial	Existing		Pre-Rinse Spray Nozzle (Full Service)	0.64 GPM	Pre-rinse spray nozzle	1.6 GPM	457	0	97,292	5	$150	0%	Both	
Commercial	New		Pre-Rinse Spray Nozzle (Limited)	0.64 GPM	Pre-rinse spray nozzle	3.0 GPM	339	0	66400	5	$150	0%	EGD	Assumption Updated in Enbridge 2011 update
Commercial	Existing		Pre-Rinse Spray Nozzle (Limited)	0.64 GPM	Pre-rinse spray nozzle	3.0 GPM	339	0	66400	5	$150	0%	Both	Assumption Updated in Enbridge 2011 update
Commercial	Existing		Pre-Rinse Spray Nozzle (Limited)	0.64 GPM	Pre-rinse spray nozzle	1.6 GPM	90	0	19,197	5	$150	0%	Both	
Commercial	New		Pre-Rinse Spray Nozzle (Other)	0.64 GPM	Pre-rinse spray nozzle	3.0 GPM	318	0	62200	5	$150	0%	EGD	Assumption Updated in Enbridge 2011 update
Commercial	Existing		Pre-Rinse Spray Nozzle (Other)	0.64 GPM	Pre-rinse spray nozzle	3.0 GPM	318	0	62200	5	$150	0%	Both	Assumption Updated in Enbridge 2011 update
Commercial	Existing		Pre-Rinse Spray Nozzle (Other)	0.64 GPM	Pre-rinse spray nozzle	1.6 GPM	109	0	23,166	5	$150	0%	Both	
Commercial	New	X	Prescriptive Higher Efficiency Boiler - DWH	83-84% Efficient, 300-1500 MBH	DWH Boiler	80% Combustion Efficiency	1,075-4,317	0	0	25	$3900 -$5900	10/12/20%	Both	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)

Witnesses: A. Mandyam
J. Ramsay

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Target Market		Union	Equipment Details				Annual Resource Savings			Other				
Sector	New/Existing	Deep Measure	Efficient Equipment	Details of Efficient Equipment	Base Equipment	Details of Base Equipment	Natural Gas (m3)	Electricity (kWh)	Water (L)	EUL	Incremental Cost ($)	Free Rider (%)	Utility Measure Applies to	Reference
Commercial	New	X	Prescriptive Higher Efficiency Boiler - DWH	85-88% Efficient, 300-1500 MBH	DWH Boiler	80% Combustion Efficiency	1,766-7,095	0	0	25	$4500-$7400	10/12/20%	Both	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Commercial	Existing	X	Prescriptive Higher Efficiency Boiler - DWH	83-84% Efficient, 300-1500 MBH	DWH Boiler	80% Combustion Efficiency	1,075-4,317	0	0	25	$3900 -$5900	10/12/20%	Both	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Commercial	Existing	X	Prescriptive Higher Efficiency Boiler - DWH	85-88% Efficient, 300-1500 MBH	DWH Boiler	80% Combustion Efficiency	1,766-7,095	0	0	25	$4500-$7400	10/12/20%	Both	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Commercial	New	X	Tankless Water Heater	100 USG/day, 84% thermal efficiency	Conventional Storage Tank Water Heater	80% thermal efficiency	154	0	0	18	(-)$1,102	2%	Both	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Commercial	Existing	X	Tankless Water Heater	100 USG/day, 84% thermal efficiency	Conventional Storage Tank Water Heater	80% thermal efficiency	154	0	0	18	(-)$1,102	2%	Both	from Enbridge 2011 update (EB-2011-0254, July 4, 2011)
Multi-Family Water Heating														
Multi-Family	New/Existing	X	CEE Tier 2 Front-Loading Clothes Washer	MEF=2.20, WF=5.1	Conventional top-loading, vertical axis clothes washer	MEF=1.26, WF=9.5	117	396	58,121	11	$600	10%	Both	
Multi-Family	New/Existing	X	Energy Star Front-Loading Clothes Washer	MEF=1.72 ,WF=8.0	Conventional top loading vertical axis washers	MEF = 1.26, WF=9.5	76	201	19,814	11	$150	48%	UG	
MultiFamily	Existing		Faucet Aerator	Bathroom, 1.0 GPM	Average Existing Stock		7	0	2371	10	$1.5	10%	EGD	
MultiFamily	Existing		Faucet Aerator	Bathroom, 1.5 GPM	Average Existing Stock		4	0	1382	10	$2.	10%	EGD	
MultiFamily	Existing		Faucet Aerator	Kitchen, 1.0 GPM	Average Existing Stock		24	0	8072	10	$2.	10%	EGD	
Multi-Family	New		Faucet Aerator	Kitchen, 1.0 GPM	Ontario Building Code 2006	2.2 GPM	22	0	7,337	10	$1.59	10%	UG	Costs as per utility program costs, bulk purchase.
MultiFamily	Existing		Faucet Aerator	Kitchen, 1.5 GPM	Average Existing Stock		16	0	5377	10	$2.	10%	EGD	
Multi-Family	New		Faucet Aerator	Bathroom, 1.0 GPM	Ontario Building Code 2006	2.2 GPM	7	0	2,371	10	$0.59	10%	UG	Costs as per utility program costs, bulk purchase.
Multi-Family	Existing		Faucet Aerator	Bathroom, 1.0 GPM	Average existing stock	2.2 GPM	7	0	2,371	10	$0.59	10%	UG	Costs as per utility program costs, bulk purchase.
Multi-Family	New		Faucet Aerator	Bathroom, 1.5 GPM	Ontario Building Code 2006	2.2 GPM	4	0	1,382	10	$0.49	10%	UG	Costs as per utility program costs, bulk purchase.
Multi-Family	Existing		Faucet Aerator	Bathroom, 1.5 GPM	Average existing stock	2.2 GPM	4	0	1,382	10	$0.49	10%	UG	Costs as per utility program costs, bulk purchase.
Multi-Family	New		Faucet Aerator	Kitchen 1.5 GPM	Ontario Building Code 2006	2.2 GPM	13	0	4,280	10	$1.29	10%	UG	Costs as per utility program costs, bulk purchase.
Multi-Family	Existing		Faucet Aerator	Kitchen, 1.0 GPM	Average existing stock	2.5 GPM	24	0	8,072	10	$1.59	10%	UG	Costs as per utility program costs, bulk purchase.
Multi-Family	Existing		Faucet Aerator	Kitchen, 1.5 GPM	Average existing stock	2.5 GPM	16	0	5,377	10	$1.29	10%	UG	Costs as per utility program costs, bulk purchase.
Multi-Family	New/Existing		Low-Flow Showerhead - (MF ONLY)	1.25gpm	replacing existing 2.0gpm	2.0 GPM	24	0	7,933	10	$3.79	10%	UG	as per Union Filing June 15, 2011 (EB-2011-0225), with updated utility costs
Multi-Family	New		Low-flow showerhead (Distributed)	1.25 GPM	Average existing stock	2.2 GPM	32	0	9,585	10	$3.79	10%	UG	Costs as per utility program costs, bulk purchase.
Multi-Family	Existing		Low-flow showerhead (Distributed)	1.25 GPM	Average existing stock	2.2 GPM	32	0	9,585	10	$3.79	10%	UG	Costs as per utility program costs, bulk purchase.
Multi-Family	New		Low-flow showerhead (Distributed)	1.5 GPM		2.2 GPM	33	0	5,228	10	$6	10%	UG	Costs as per utility program costs, bulk purchase.
Multi-Family	Existing		Low-flow showerhead (Distributed)	1.5 GPM	Average existing stock	2.2 GPM	33	0	5,228	10	$6	10%	UG	Costs as per utility program costs, bulk purchase.
MultiFamily	New		Low-Flow Showerhead (Per household, Installed)	1.25 GPM		2.5 GPM	36	-	11587	10	$12.5	10%	EGD	New Measure added by Enbridge in EGD's 2011 update
MultiFamily	New		Low-Flow Showerhead (Per household, Installed)	1.5 GPM		2.5 GPM	29	-	7818	10	$12.5	10%	EGD	New Measure added by Enbridge in EGD's 2011 update
MultiFamily	Existing		Low-Flow Showerhead (Per household, Installed)	1.5 GPM	2.0 -2.5 GPM showerhead	2.25 GPM	21	0	5931	10	$12.5	10%	EGD	Assumption Updated in Enbridge 2011 update.
MultiFamily	Existing		Low-Flow Showerhead (Per household, Installed)	1.5 GPM	2.6 -3.0 GPM GPM showerhead	2.8 GPM	40	0	10036	10	$12.5	10%	EGD	Assumption Updated in Enbridge 2011 update.
MultiFamily	Existing		Low-Flow Showerhead (Per household, Installed)	1.5 GPM	3.1 - 3.5 GPM showerhead	3.3 GPM	58	0	13621	10	$12.5	10%	EGD	Assumption Updated in Enbridge 2011 update.
MultiFamily	Existing		Low-Flow Showerhead (Per household, Installed)	1.5 GPM	3.6 GPM and above	3.6 GPM	69	0	15705	10	$12.5	10%	EGD	Assumption Updated in Enbridge 2011 update.

* Efficiency ratings and natural gas savings will vary by fireplace type. Please see substantiation sheet for type specific efficiency ratings and savings.

** Savings will vary for different segments. Please see substantiation sheet for segment specific savings.

Union Gas Custom Projects

Sector	Union Deep Measure	Free Rider (%)
Agriculture	X	54%
Industrial	X	54%
Commercial	X	54%
Multi-Residential	X	54%
New Construction	X	54%
Low-Income - Weatherization	X	0%

Enbridge Custom Projects

Sector	Free Rider (%)
Agriculture	40%
Industrial	50%
Commercial	12%
Multi-Residential	20%
New construction	26%

Witnesses: A. Mandyam
J. Ramsay

Substantiation Documents 2012 DSM Plan

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ENERGY STAR FOR NEW HOMES (VERSION 3)

Residential, New Construction

Efficient Technology & Equipment Description
Energy Star for New Homes, version 3, qualified home
Base Technology & Equipment Description
New Home built in Ontario, compliant to OBC-2006, permits issued prior to March 31, 2009.

Resource Savings Assumptions

Natural Gas	**1018 m^3**
As approved in EB 2008-0384 & 0385. Gas savings is based on a simple average of a new reference house, a 1 storey house, and a 2 storey house[1] with London's climate, and another set in North Bay's climate. The sample houses are three houses which represent the mid-range of new homes built in UG Territory. The results were weighted 70% UG South and 30% UG North. The software used for analysis is HOT2000 version 9.34b. This is the same software that is currently in use for application of the EnerQuality Version 3.0 Energy Star Criteria, which is what's mandatory to evaluate homes for ESNH. A mix of 90% AFUE furnace (weighted 80%) and 80% AFUE combo heater (weighted 20%) was assumed as the base case heating system. The upgrade system was a 92% AFUE. A 3.57 ACH50 air leakage was used to describe the simply OBC-2006 houses (default present in HOT2000), which is representative of average new home construction[2]	
Electricity	**1450 kWh**
As approved in EB 2008-384 & 0384. Electrical savings is based on a simple average of a new reference house, a 1 storey house, and a 2 storey house[1] with London's climate, and another set in North Bay's climate. The sample houses are three houses which represent the mid-range of new homes built in UG Territory.[1] The results were weighted 70% UG South and 30% UG North. The software used for analysis is HOT2000 version 9.34b. This is the same software that is currently in use for application of the EnerQuality Version 3.0 Energy Star Criteria, which is what's mandatory to evaluate homes for ESNH. A 3.57 ACH50 air leakage was used to describe the simply OBC-2006 houses (default present in HOT2000), which is representative of average new home construction[3]	
Water	**n/a L**

[1] Based on *Comparison of EnergyStar vs.Ontario Building Code 2006 Energy Use*, spreadsheets, from July and August, 2008, by Bowser Technical Inc.
[2] Conversation with Jennifer Tausman, ESNH files coordinator, NRCAN OEE, July 21, 2008
[3]The EnerQuality EnergyStar Version 4.0 Prescriptive options are not applicable to homes North of the Muskoka climate zone. Upgrades are based on the performance Compliance Method (section 5.1) as set out in the EnerQuality EnergyStar for New Homes Technical Specification Version 4.0, February '09..

Other Input Assumptions

Equipment Life	**25 years**
As approved in EB 2008-0384 & 0385. Energy Star homes have an estimated service life of 25 years (before major renovations are expected)	
Incremental Cost (Installed)	**$3,200**
As per Costing Analysis of Energy Star version 3 Specifications over the 2006 Ontario Building Code by Lio & Associates, May 2011.	
Free Ridership	**48 %**
As per 2009 Audit recommendation. Based on Auditors review of the Salt River Project (SRP) Powerwise Homes program (FY2009) in Arizona.	

HIGH EFFICIENCY CONDENSING FURNACE

Residential Existing Homes

Efficient Technology & Equipment Description
High efficiency condensing furnace with regular PSC motor – AFUE 96
Base Technology & Equipment Description
Minimum standard gas fired furnace AFUE 90

Resource Savings Assumptions

Natural Gas	**129 m^3**
As approved in EB 2008-0346	
Electricity	**n/a kWh**
Water	**n/a L**

Other Input Assumptions

Equipment Life	**18 years**
As approved in EB 2008-0346	
Incremental Cost (Contractor Install)	**$1767.00**
As approved in EB 2008-0346	
Free Ridership (Updated)	**N/A**

HIGH EFFICIENCY FIREPLACE WITH PILOTLESS IGNITION

Residential –New & Existing Homes

Efficient Technology & Equipment Description	
A new high efficiency fireplace with intermittent (pilotless) ignition	
Type	EnerGuide Rating *(Minimum)*
Freestanding fireplace	70%
Insert	60%
Zero Clearance >= 40 kBtu/h	60%
Zero Clearance < 40 kBtu/h	70%
Base Technology & Equipment Description	
A typical natural gas fireplace based on the median fireplace model	
Type	Median Efficiency
Freestanding fireplace	65%
Insert	55%
Zero Clearance >= 40 kBtu/h	55%
Zero Clearance < 40 kBtu/h	65%

Resource Savings Assumptions

Natural Gas	**See Below**
Type	**Gas Savings (m3/yr)**
Freestanding fireplace	**110**
Insert	**109**
Zero Clearance >= 40 kBtu/h[1]	**122**
Zero Clearance < 40 kBtu/h[2]	**108**

The savings above is based on

1. A 5-percentage point efficiency increase above the median model efficiency according to the EnerGuide Rating
2. Pilotless (intermittent) ignition (i.e. gas saved from the standing pilot burner)

The table below shows gas use from the main burner (not including the standing pilot) and the EnerGuide ratings mentioned above.

Type	Input (BTU/H)[3]	Oper. Hours[4]	Base (m3/yr)	Heat Load (BTU/yr)	Upgrade (m3/yr)	Savings (m3/yr)
Freestanding	32,000	178	161	3,702,400	150	12
Insert	25,000	178	126	2,447,500	116	11

[1] Calculated at 55 kBtu/h
[2] Calculated at 25 kBtu/h
[3] Median fireplace input capacity, from LeapFrog Consulting, Market Assessment for Potential Natural Gas Fireplace DSM Initiatives by Union Gas in Ontario, Union Gas Fireplace Consolodated Presentation 071221.ppt slide 24
[4] 178 hrs/yr = 8.9 hrs/week for 20 weeks (~5 months) of use, according to Leapfrog Energy Technologies' conversations with retailers and fireplace owners and weighted average use behavior per week from NRCAN 2003 Survey of Household Energy Use results(as per slide 19 of Leapfrog's presentation, Market Assessment for Potential Natural Gas Fireplace DSM Initiatives by Union Gas in Ontario, 2007

Zero Clearance	55,000	178	277	5,384,500	254	23
Zero Clearance	25,000	178	126	2,892,500	117	9

The EnerGuide rating uses the CSA P.4.1-02 Efficiency Standard, which is supposed to include the pilot light. However the average efficiency point improvement between an intermittent ignition and a standing pilot light ignition according to this rating is only about 2 percentage points. This was based on looking at the average difference between Vermont Casting fireplace models with & without intermittent ignition.[5] The efficiency values include only a small portion of the gas consumption from the pilot (5.5 m3/yr). This portion is subtracted off in the gas savings calculation so as to not double count the intermittent ignition savings.

The intermittent ignition gas savings value is based on the gas normally consumed by a pilot flame during the winter and the non-heating season discounted by the fraction of households who shut off their gas pilot in the non-heating season according to the NRCAN SHEU study[6]. The pilot flame is estimated to consume 700 Btu/hr (which is at the lower end of the published values).[7],[8] The table below[9] shows approximately how much gas is consumed by a pilot flame in the heating and non-heating seasons.

Operation Mode	Btu/hr	~m3/hr	Annual hours	m3 Gas Per Year
Pilot Light- Heating Season	700	0.02	4,932[10]	96.6
Pilot Light - Non-Heating Season	700	0.02	3,650[11]	71.5

The table below shows the effects on the gas savings estimates from fireplace owners who shut off their pilot lights during the non-heating season.

	Annual m3	Percent of Fireplace Owners	Weighted Average (m3/yr)
Standing Pilot Use in Heating Season	96.6	100%	96.6
Standing Pilot Use in Non-Heating Season	71.5	38%[12]	27.2

[5] from slide 17, LeapFrog Consulting, Union Gas Fireplace Consolodated Presentation 071221.ppt
[6] Table 3.4 "NRCan - 2003 Survey of Household Energy Use" – 38% of households in Ontario do not extinguish pilot lights in non-heating season
[7] Leapfrog Energy Technologies, Market Assessment for Potential Natural Gas Fireplace DSM Initiatives, 2007, Union Gas Fireplace Consolodated Presentation 071221.ppt, slide 18.
[8] "A pilot light…can consume from 600 to 1500 Btu of gas per hour and, if left to run continuously, can significantly increase your annual energy costs." – "All About Gas Fireplaces", Office of Energy Efficiency, Natural Resources Canada – March 2004
[9] From Fireplace Backup Calculations for Pete 071221.xls
[10] The heating season was estimated to last for 7 months. This value is also used in the CSA Fireplace Efficiency standard. The time that the pilot light runs during the heating season is 7 months/12 months X 365 days X 24 hours MINUS the number of hours when the fireplace is actually running.
[11] The non-heating hours per year are equivalent to 8760 minus the time that the fireplace is running and minus the time when the pilot flame is running during the heating season.

A small portion of the wintertime pilot gas heat is assumed to contribute to space heating during the heating season; however, the actual value is unknown. A nominal value of 20% was estimated by Skip Hayden of NRCAN to be the highest likely value[13].

104 m3/yr = 27.2 m3/yr + (96.6 m3/yr * 80%)

Gas savings =
Savings from EnerGuide Rating improvement (*5 percentage points above median*)
+ (plus) intermittent (pilotless) ignition
– (minus) intermittent ignition savings already accounted for in the EnerGuide Rating[14]

Freestanding	110 m3/yr = 12 m3/yr + 104 m3/yr – 5.5 m3/yr
Insert	109 m3/yr = 11 m3/yr + 104 m3/yr – 5.5 m3/yr
Zero Clearance >= 40 kBtu/h[15]	122 m3/yr = 23 m3/yr + 104 m3/yr – 5.5 m3/yr
Zero Clearance < 40 kBtu/h[16]	109 m3/yr = 11 m3/yr + 104 m3/yr – 5.5 m3/yr

Electricity	**(-) 31 kWh/yr**

Intermittent ignition systems actually increase electricity consumption. The power supply for the electronic fireplace ignition consumes standby power anywhere from 2 Watts[17] to 5 Watts[18]. Power is drawn continuously through the year (8760 hours). The corresponding annual power consumption ranges from 17.5 to 43.8 kWh.

31 kWh/yr represents the average between 17.5 and 43.8 kWh

Water	**NA**

Other Input Assumptions

Equipment Life	**20 yrs**

Equipment life was estimated from manufacturer technical service reps.[19]

Incremental Cost	**$135**

The incremental cost for higher efficiency model fireplaces is 0 (Zero). Higher efficiency fireplaces don't cost more than lower efficiency fireplaces. Correlations were drawn and

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[12] Table 3.4 "NRCan - 2003 Survey of Household Energy Use" – 38% of households in Ontario do not extinguish pilot lights in non-heating season.
[13] Agreed upon at UG-EAC meeting April 15, 2010.
[14] 5.5 m3/yr = 1.98% * 280 m3/yr. "The average efficiency point improvement between an intermittent ignition and a standing pilot light ignition is approximately 2 percentage points." This was based on looking at the average difference between Vermont Casting fireplace models with the same fireboxes with & without intermittent ignition from slide 17, LeapFrog Consulting, *Union Gas Fireplace Consolodated Presentation 071221.ppt.* The UG fireplace NAC is 280 m3/yr, (Paul Gardiner UG forecasting, Oct 3, 2007 email to Pete Koepfgen).
[15] Calculated at 25 kBtu/h
[16] Calculated at 55 kBtu/h
[17] LeapFrog Energy Technology's phone conversations with Jatin at Majestic Fireplace technical services on 30/01/08.
[18] LeapFrog Energy Technology's phone conversations with Stan at ESA Heating Products technical services 30/01/08.
[19] LeapFrog Energy Technology's phone conversations with Jatin at Majestic Fireplace technical services on 30/01/08 and to Stan at ESA Heating Products technical services 30/01/08

the R^2 values were around 0.3-0.4. The incremental cost for new fireplace models that include an intermittent control are $120-150[20] above models with just a pilot light. The simple average of these values was used ($135).	
Free Ridership	**17 %**
Free ridership based on Enbridge research with builders regarding percentage of fireplaces with intermittent ignition installed in new homes and HPBAC (Hearth, Patio, Barbeque Association of Canada) information that 2009 sales of electronic spark fireplaces in Ontario is between 10-20%.	

[21] Calculated at 55 kBtu/h
[22] Calculated at 25 kBtu/h
[23] Median fireplace input capacity, from LeapFrog Consulting, Market Assessment for Potential Natural Gas Fireplace DSM Initiatives by Union Gas in Ontario, Union Gas Fireplace Consolodated Presentation 071221.ppt slide 24
[24] 178 hrs/yr = 8.9 hrs/week for 20 weeks (~5 months) of use, according to Leapfrog Energy Technologies' conversations with retailers and fireplace owners and weighted average use behavior per week from NRCAN 2003 Survey of Household Energy Use results(as per slide 19 of Leapfrog's presentation, Market Assessment for Potential Natural Gas Fireplace DSM Initiatives by Union Gas in Ontario, 2007
[25] from slide 17, LeapFrog Consulting, Union Gas Fireplace Consolodated Presentation 071221.ppt
[26] Table 3.4 "NRCan - 2003 Survey of Household Energy Use" – 38% of households in Ontario do not extinguish pilot lights in non-heating season
[27] Leapfrog Energy Technologies, Market Assessment for Potential Natural Gas Fireplace DSM Initiatives, 2007, Union Gas Fireplace Consolodated Presentation 071221.ppt, slide 18.
[28] "A pilot light…can consume from 600 to 1500 Btu of gas per hour and, if left to run continuously, can significantly increase your annual energy costs." – "All About Gas Fireplaces", Office of Energy Efficiency, Natural Resources Canada – March 2004
[29] From Fireplace Backup Calculations for Pete 071221.xls
[30] The heating season was estimated to last for 7 months. This value is also used in the CSA Fireplace Efficiency standard. The time that the pilot light runs during the heating season is 7 months/12 months X 365 days X 24 hours MINUS the number of hours when the fireplace is actually running.
[31] The non-heating hours per year are equivalent to 8760 minus the time that the fireplace is running and minus the time when the pilot flame is running during the heating season.
[32] Table 3.4 "NRCan - 2003 Survey of Household Energy Use" – 38% of households in Ontario do not extinguish pilot lights in non-heating season.
[33] Agreed upon at UG-EAC meeting April 15, 2010.
[34] 5.5 m3/yr = 1.98% * 280 m3/yr. "The average efficiency point improvement between an intermittent ignition and a standing pilot light ignition is approximately 2 percentage points." This was based on looking at the average difference between Vermont Casting fireplace models with the same fireboxes with & without intermittent ignition from slide 17, LeapFrog Consulting, *Union Gas Fireplace Consolodated Presentation 071221.ppt.* The UG fireplace NAC is 280 m3/yr, (Paul Gardiner UG forecasting, Oct 3, 2007 email to Pete Koepfgen).
[35] Calculated at 25 kBtu/h
[36] Calculated at 55 kBtu/h
[37] LeapFrog Energy Technology's phone conversations with Jatin at Majestic Fireplace technical services on 30/01/08.
[38] LeapFrog Energy Technology's phone conversations with Stan at ESA Heating Products technical services 30/01/08.
[39] LeapFrog Energy Technology's phone conversations with Jatin at Majestic Fireplace technical services on 30/01/08 and to Stan at ESA Heating Products technical services 30/01/08

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[20] Fireplace Retailer survey within Union Gas franchise territory by LeapFrog Energy in Oct-Nov 2007

[40] Fireplace Retailer survey within Union Gas franchise territory by LeapFrog Energy in Oct-Nov 2007

PROGRAMMABLE THERMOSTAT

Residential New Construction - ESK kit

Efficient Technology & Equipment Description
Programmable thermostat
Base Technology & Equipment Description
Standard thermostat

Resource Savings Assumptions

Natural Gas	**53 m^3**
EB 2009-0154	
Electricity	**54 kWh**
EB 2009-0154	
Water	**n/a L**

Other Input Assumptions

Equipment Life	**15 Years**
EB 2009-0154	
Incremental Cost	**$53.22**
Bulk purchase of programmable thermostats for new construction ESK + Packaging etc.	
Free Ridership	**10 %**
Pre-screening will be conducted to ensure builders who install a programmable thermostat as standard are not targeted. Measure will not be delivered to Energy Star Labeled Homes. A builder survey will be conducted immediately prior to launch of the program in order to capture the majority of builders in the franchise area.	

PROGRAMMABLE THERMOSTAT

Residential Existing

Efficient Technology & Equipment Description
Programmable thermostat
Base Technology & Equipment Description
Standard manual thermostat

Resource Savings Assumptions

Natural Gas (Updated)	**53 m^3**
Savings recommended by Navigant Consulting.[1]	
Electricity (Updated)	**54 kWh**
Savings recommended by Navigant Consulting.[1]	
Water	**n/a L**

Other Input Assumptions

Equipment Life	**15 years**
Equipment life recommended by Summit Blue Consulting and as approved in EB 2008-0384 & 0385.[1]	
Incremental Cost (Contr. Install) (EGD)	**$50.00**
As per utility program costs.	
Free Ridership	**43 %**
As per EB 2008-0384 & 0385.	

[1] Draft Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. B-112-115, Feb. 6, 2009.

HEAT REFLECTOR PANELS

Residential Existing Homes

Efficient Technology & Equipment Description
A saw tooth panel made of clear PVC with a reflective surface placed behind a radiator, thereby reducing heat lost to poorly insulated exterior walls.
Base Technology & Equipment Description
Existing housing with radiant heat with no reflector panels.

Resource Savings Assumptions

Natural Gas	**143 m^3**
As approved in EB 2008-0346.	
Electricity	**kWh**
Water	**L**

Other Input Assumptions

Equipment Life	**18 Years**
As approved in EB 2008-0346	
Incremental Cost (Customer Install)	**$238**
As per utility program costs. (Cost of panels plus shipping)	
Free Ridership	**0 %**
Product not currently available to end-use consumers through typical retail channels. As approved in EB 2008-0346 & 0385.	

Residential Water Heating

1.5 GAL/MIN FAUCET AERATOR (BATHROOM)

Residential New Construction – ESK kit

Efficient Technology & Equipment Description
Faucet Aerator (Bathroom) (1.5 GPM)
Base Technology & Equipment Description
Average existing stock (2.2 GPM)

Resource Savings Assumptions

Natural Gas	**18 m^3**
6 m3 x 3 aerators being installed as approved in EB 2009-0154.	
Electricity	**n/a kWh**
Water	**6012 L**
2004 L x 3 aerators being installed as approved in EB 2009-0154.	

Other Input Assumptions

Equipment Life	**10 Years**
EB 2009-0154	
Incremental Cost (Installed)	**$2.72**
Bulk purchase for bathroom aerators for new construction ESK + Packaging x 3 aerators being installed.	
Free Ridership	**31 %**
EB 2009-0154	

1.0 GAL/MIN FAUCET AERATOR (Bathroom)

Residential New Construction

Efficient Technology & Equipment Description
Faucet Aerator (Bathroom) (1.0 GPM)
Base Technology & Equipment Description
Average existing stock & Ontario Building Code 2006 maximum allowed (2.2 GPM)

Resource Savings Assumptions

Natural Gas (Updated)	10	m^3
Savings recommended by Navigant Consulting. [1] adjusted for 1.0 GPM		
Electricity	n/a	kWh
Water (Updated)	3,435	L
Savings recommended by Navigant Consulting[1] adjusted for 1.0 GPM		

Other Input Assumptions

Equipment Life	10	Years
Faucet aerators have an estimated service life of 10 years.[1, 2] As approved in EB 2008-0384 & 0385.		
Incremental Cost	$0.55	
As per utility program costs, bulk purchase of aerators.		
Free Ridership	31	%
Free Ridership rate recommended by Summit Blue Consulting.[3] As approved in EB 2008-0384 & 0385.		

[1] Final Report “Measures and Assumptions for Demand Side Management (DSM) Planning”, Navigant Consulting Inc., Ontario Energy Board, April 16, 2009

[2] U.S. DOE – FEMP, Energy Cost Calculator for Faucets and Showerheads, http://www.eere.energy.gov/femp

[3] “Residential Measure Free Ridership And Inside Spillover Study - Final Report”, Summit Blue Consulting, June 2008.

1.0 GAL/MIN FAUCET AERATOR (BATHROOM)

Residential Existing Homes

Efficient Technology & Equipment Description
Faucet Aerator (Bathroom) (1.0 GPM)
Base Technology & Equipment Description
Average existing stock & Ontario Building Code 2006 maximum allowed (2.2 GPM)

Resource Savings Assumptions

Natural Gas (Updated)	**10 m^3**
Savings recommended by Navigant Consulting.[1] adjusted for 1.0 GPM	
Electricity	**n/a kWh**
Water (Updated)	**3,435 L**
Savings recommended by Navigant Consulting[1] adjusted for 1.0 GPM	

Other Input Assumptions

Equipment Life	**10 Years**
Faucet aerators have an estimated service life of 10 years.[1, 2] As approved in EB 2008-0384 & 0385.	
Incremental Cost	**$0.55**
As per utility program costs, bulk purchase of aerators.	
Free Ridership	**31 %**
Free Ridership rate recommended by Summit Blue Consulting.[3] As approved in EB 2008-0384 & 0385.	

[1] Final Report “Measures and Assumptions for Demand Side Management (DSM) Planning”, Navigant Consulting Inc., Ontario Energy Board, April 16, 2009

[2] U.S. DOE – FEMP, Energy Cost Calculator for Faucets and Showerheads, http://www.eere.energy.gov/femp

[3] “Residential Measure Free Ridership And Inside Spillover Study - Final Report”, Summit Blue Consulting, June 2008.

1.5 GAL/MIN FAUCET AERATOR (BATHROOM)

Residential Existing Homes

Efficient Technology & Equipment Description
Faucet Aerator (Bathroom) (1.5 GPM)
Base Technology & Equipment Description
Average existing stock (2.2 GPM)

Resource Savings Assumptions

Natural Gas	**6 m^3**
As approved in EB 2008-0346	
Electricity	**n/a kWh**
Water (Updated)	**2,004 L**
As approved in EB 2008-0346	

Other Input Assumptions

Equipment Life	**10 Years**
As approved in EB 2008-0346	
Incremental Cost (Cust. Install) (UG/EGD)	**$1**
As per utility program costs, bulk purchase of aerators.	
Free Ridership (UG/EGD)	**33/31 %**
Free Ridership rate recommended by Summit Blue Consulting.[1] As approved in EB 2008-0384 & 0385.	

[1] "Residential Measure Free Ridership And Inside Spillover Study - Final Report", Summit Blue Consulting, June 2008.

1.0 GAL/MIN FAUCET AERATOR (Kitchen)

Residential New Construction

Efficient Technology & Equipment Description
Faucet Aerator (Kitchen) (1.0 GPM)
Base Technology & Equipment Description
Ontario Building Code 2006 (2.2 GPM)

Resource Savings Assumptions

Natural Gas	32 m^3
Savings based on Navigant's[1], except using 2.2 USGPM base case (opposed to 2.5) and 1.0 GPM efficient technology case	
Electricity	n/a kWh
Water	10,631 L
Savings based on Navigant's[1], except using 2.2 USGPM base case (opposed to 2.5) and 1.0 GPM efficient technology case	

Other Input Assumptions

Equipment Life	10 years
Faucet aerators have an estimated service life of 10 years. [2] As approved in EB 2008-0384 & 0385.	
Incremental Cost	$1.00
As per utility program costs, bulk purchase of aerators.	
Free Ridership	31 %
Free Ridership rate recommended by Summit Blue Consulting.[3] As approved in EB 2008-0384 & 0385.	

[1] Final Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. C60-63, April 16, 2009.

[2] U.S. DOE – FEMP, Energy Cost Calculator for Faucets and Showerheads, http://www.eere.energy.gov/femp

[3] "Residential Measure Free Ridership And Inside Spillover Study - Final Report", Summit Blue Consulting, June 2008.

1.0 GAL/MIN FAUCET AERATOR (KITCHEN)

Residential Existing Homes

Efficient Technology & Equipment Description
Faucet Aerator (Kitchen) (1.0 GPM)
Base Technology & Equipment Description
Average existing stock – 2.5 GPM Faucet Aerator (Kitchen)

Resource Savings Assumptions

Natural Gas	**35 m^3**
Savings based on Navigant's[1], except using a 1.0 GPM efficient technology case	
Electricity	**n/a kWh**
Water	**11,694 L**
Savings based on Navigant's[1], except using a 1.0 GPM efficient technology case	

Other Input Assumptions

Equipment Life	**10 years**
Faucet aerators have an estimated service life of 10 years.[2] As approved in EB 2008-0384 & 0385.	
Incremental Cost	**$1.00**
As per utility program costs, bulk purchase of aerators.	
Free Ridership	**31 %**
Free Ridership rate recommended by Summit Blue Consulting.[3] As approved in EB 2008-0384 & 0385.	

[1] Final Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. C60-63, April 16, 2009.

[2] U.S. DOE – FEMP, Energy Cost Calculator for Faucets and Showerheads, http://www.eere.energy.gov/femp

[3] "Residential Measure Free Ridership And Inside Spillover Study - Final Report", Summit Blue Consulting, June 2008.

1.5 GAL/MIN FAUCET AERATOR (KITCHEN)

Residential New Construction – ESK kit

Efficient Technology & Equipment Description
Faucet Aerator (Kitchen) (1.5 GPM)
Base Technology & Equipment Description
Average existing stock (2.5 GPM)

Resource Savings Assumptions

Natural Gas	**23 m^3**
EB 2009-0154	
Electricity	**n/a kWh**
Water	**7,797 L**
EB 2009-0154	

Other Input Assumptions

Equipment Life	**10 Years**
EB 2009-0154	
Incremental Cost (Installed)	**$1.65**
Bulk purchase of kitchen aerators for new construction ESK + Packaging	
Free Ridership	**31 %**
EB 2009-0154	

1.5 GAL/MIN FAUCET AERATOR (KITCHEN)

Residential Existing Homes

Efficient Technology & Equipment Description
Faucet Aerator (Kitchen) (1.5 GPM)
Base Technology & Equipment Description
Average existing stock (2.5 GPM)

Resource Savings Assumptions

Natural Gas	**23 m^3**
As approved in EB 2008-0346	
Electricity	**n/a kWh**
Water (Updated)	**7,797 L**
As approved in EB 2008-0346	

Other Input Assumptions

Equipment Life	**10 years**
As approved in EB 2008-0346	
Incremental Cost (Cust. Install) (UG/EGD)	**$1**
As per utility program costs, bulk purchase of aerators.	
Free Ridership (UG/EGD)	**33/31 %**
Free Ridership rate recommended by Summit Blue Consulting.[1] As approved in EB 2008-0384 & 0385.	

[1] "Residential Measure Free Ridership And Inside Spillover Study - Final Report", Summit Blue Consulting, June 2008.

Low-Flow Showerhead (Various GPM, Enbridge TAPS, ESK and Multi-Family)

Revision #	Description/Comment	Date Revised
		September 20, 2010

Efficient Equipment and Technologies Description

Low-flow Showerhead (1.25 or 1.5 GPM) – distributed to participants under Enbridge's TAPS program, Enbridge's ESK program, Enbridge's Multi-Family program and Enbridge's Low-Income program.

Base Equipment and Technologies Description

Enbridge TAPS (existing only)	– 2.45 GPM or – 3.07 GPM[1]
Enbridge ESK (new only)	– Maximum allowable by OBC (2.5 GPM)
Enbridge Multi-Family (MF) (existing only)	– 2.25 GPM – 2.8 GPM – 3.3 GPM – 3.6 GPM[2]
Enbridge Multi-Family (MF) (new only)	– Maximum allowable by OBC (2.5 GPM)
Enbridge Low-Income	– 2.45 GPM or – 3.07[3]

Decision Type	Target Market(s)	End Use
Enbridge TAPS - Existing, Enbridge ESK – New Only, Enbridge MF – New and Existing	Residential, Low-Income, Multi-family	Water heating

[1] Enbridge load research indicates that that the average bag-tested flow rate for showerheads that fall within the 2.0 – 2.5 GPM bucket is 2.45 GPM and that the average bag-tested flow rate for showerheads that fall within the >2.5 GPM bucket is 3.07.

[2] Enbridge contractors install the showerheads as part of the Enbridge Multi-Family program. The base measure is reported as falling in one of four buckets, 2.0 – 2.5 GPM, 2.6 – 3.0 GPM, 3.1 – 3.5 GPM and greater than 3.6 GPM. Navigant has assumed that in each case the average base technology GPM for each of the first three buckets is the mid-point and that the average GPM for the fourth bucket is the lowest possible value; 3.6 GPM

[3] The average GPM of low-income households' showerheads is assumed by Navigant to be no different than that of standard single family households'.

Codes, Standards, and Regulations

Ontario Building Code (2006)[4] requires shower heads to have a maximum flow of 2.5 GPM (9.5 L/min).

Resource Savings Table

Year (EUL=)	Electricity and Other Resource Savings: Natural Gas (m^3)	Electricity (kWh)	Water (L)	Equipment & O&M Costs of Conservation Measure ($)	Equipment & O&M Costs of Base Measure ($)
1	21 – 82	0	5,931 – 23,374	6	0
2	21 – 82	0	5,931 – 23,374	0	0
3	21 – 82	0	5,931 – 23,374	0	0
4	21 – 82	0	5,931 – 23,374	0	0
5	21 – 82	0	5,931 – 23,374	0	0
6	21 – 82	0	5,931 – 23,374	0	0
7	21 – 82	0	5,931 – 23,374	0	0
8	21 – 82	0	5,931 – 23,374	0	0
9	21 – 82	0	5,931 – 23,374	0	0
10	21 – 82	0	5,931 – 23,374	0	0
TOTALS	**215 - 815**	**0**	**59,307 – 233,744**	**EG TAPS 1.25 GPM = $19.00 EG LI 1.25 GPM = $18.71 EG ESK 1.25 GPM = $4.26 EG ESK 1.5 GPM = $12.50 EG ESK 1.5 & 1.25 GPM = $16.76 EG Multi-Fam 1.5 GPM = $12.50 EG Multi-Fam 1.25 GPM = $12.50**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	21 – 82 m^3

Enbridge Gas commissioned a study by the SAS Institute (Canada)[5] to estimate natural gas savings for low-flow showerheads in Enbridge territory. Data was collected August 31, 2007 until August 31, 2009 for both treatment and control groups. Low flow showerheads were installed in treatment households between August 13, 2008 and October 30, 2008. There were 54 households with low-flow showerheads and 124 households without low-flow showerheads.

To calculate the gas savings, three different models were used to analyze the gas consumption data

1) a comparison made during the same time frame (post-installation) between a control set of households[6] and households that had them installed
2) a Pre & Post installation analysis on the same households, and
3) a complex time trend model analysis that factored in many household characteristics over the whole Pre & Post time period.

All three analyses agreed well with each other.[7]

Three buckets for pre-existing showerheads were originally proposed. However, the lowest flow bucket (2.0 GPM or less) had too few observations and are rare in the population of households. The natural gas savings for the other two buckets are estimated to be as follows:

[4] Ontario Regulations 350/06, 2006 Building Code
[5] Rothman, Lorne, SAS® PHASE II Analysis for Enbridge Gas Distribution Inc.: Estimating the Impact of Low-Flow Showerhead Installation; April 5, 2010
[6] Where no low-flow showerheads were ever installed
[7] Model 1 – a blended rate of 71.3 m3/yr (only models II and II provided bucketed savings estimates)
Model 2 – a blended rate of 67.4 m3/yr (45.4 m3/yr for 2 to 2.5 GPM bucket and 87.8 m3/yr for over 2.5 GPM), and
Model 3 – a blended rate of 77.2 m3/yr (46.4 m3/yr for 2 to 2.5 GPM bucket and 87.9 m3/yr for over 2.5 GPM).

Table 1 - SAS Study Results

Bucket for Base Showerhead	Average Flow Rate of SAS Sample (GPM)	Annual Natural Gas Savings (m3)
2.0 to 2.5 GPM	2.36	46
> 2.5 GPM	3.19	88

To extrapolate the savings estimates reported in the SAS study to the base technologies under consideration several steps are required.

1. Estimate the "as-used" flow of the base and efficient technologies.

In its report on showerhead savings, Summit Blue[8], notes that the actual flow-rate as used in showers has been found to differ somewhat from the nominal flow-rate. Citing a 1994 California study, they provide an equation for calculating the "as-used" flow:

As-used flow rate (GPM) = 0.691 + 0.542*Nominal flow rate (GPM)

Navigant notes that applying this equation to a showerhead with a 1.25 GPM flow rate would result in an as-used flow rate that is greater than the nominal flow rate. Navigant has therefore applied a somewhat modified version of the equation above to determine the as-used flow rate. The as-used flow rate is estimated to be the minimum of either the result of the equation above or the nominal flow rate.

Applying the modified equation to Table 1, above, we obtain the following:

Table 2 - As-Used Flow

Nominal Flow (GPM)		As-Used Flow (GPM)		Delta As-Used Flow (GPM)	Observed Savings (m^3)
Base Technology	Efficient Measure	Base Technology	Efficient Measure		
2.36	1.25	1.97	1.25	0.72	46
3.19	1.25	2.42	1.25	1.17	88

2. Estimate the average annual natural gas consumption of a 1.25 GPM showerhead.

Based on the values above, Navigant has estimated that the annual natural gas consumption of the 1.25 GPM showerhead is 87 m^3 per year.

Table 3 - Annual Natural Gas Consumption of a 1.25 GPM Showerhead

Delta As-Used Flow (GPM)	Observed Savings (m^3)	Efficient Technology As-Used Flow (GPM)	Implied Annual Gas Consumption of Efficient Technology (m^3)	Average (m^3)
A	B	C	D = (C/A)*B	E = Average(D)
0.72	46	1.25	80	87
1.17	88	1.25	94	

[8] Summit Blue, *Resource Savings Values in Selected Residential DSM Prescriptive Programs*, prepared for Union Gas and Enbridge Gas Distribution, June 2008

3. **Extrapolate the implied annual natural gas consumption of showerheads in both buckets identified by the SAS Institute.**

Extrapolating these values is simply a matter of adding the estimated savings by bucket to the estimated annual consumption of the 1.25 GPM showerhead.

Table 4 - Implied Annual Natural Gas Consumption by Showerhead Flow Rate

Nominal Flow Rate (GPM)	Implied Annual Natural Gas Consumption (m3)
1.25	87
2.36	133
3.19	175

4. Estimate an equation from which the annual natural gas consumption of showerheads with flow rates different to those above may be extrapolated.

Fitting a polynomial equation to the three data-points in Table 4 above delivers the following equation which may be used to extrapolate the annual natural gas consumption of a given showerhead:

$$y = 49.06 + 24.39x + 4.72x^2$$

Where:

y = Annual natural gas consumption (m^3)
x = Nominal GPM of showerhead

Navigant notes that given the manner in which this equation was derived, and the values of the parameters, it may be inappropriate to use this equation to extrapolate the annual natural gas consumption of showerheads with a nominal flow rate that is less than 1.25 GPM.

In multi-family homes, Navigant has adjusted savings based on number of occupants per household to reflect differences in patterns of use. The adjustment factor is the fraction of average number of occupants per household in an apartment building over the average number of occupants per household in a single-detached house[9]. This factor is (2/2.9) = 69% for buildings over 5 stories and (1.9/2.9) = 66% for buildings of five stories or less. The average of these two factors, weighted by the number of each type of household is 68%.

It should be noted that the savings below are per household and predicated on the assumption that all showers taken in that household are taken using a shower with the low-flow showerhead. In the program measurement and verification stage, Enbridge will undertake to determine what proportion of showers per household were taken with the efficient measure and apply this factor to previously calculated savings.

[9] Statistics Canada. *Structural Type of Dwelling (10) and Household Size (9) for Occupied Private Dwellings of Canada, Provinces, Territories, Census Metropolitan Areas and Census Agglomerations, 2006 Census - 100% Data* (Table) *Census 2006.* Last updated Dec 6, 2008.
http://www12.statcan.ca/english/census06/data/topics/RetrieveProductTable.cfm?ALEVEL=3&APATH=3&CATNO=&DETAIL=0&DIM=&DS=99&FL=0&FREE=0&GAL=0&GC=99&GID=837983&GK=NA&GRP=1&IPS=&METH=0&ORDER=1&PID=89071&PTYPE=88971&RL=0&S=1&SUB=0&ShowAll=No&StartRow=1&Temporal=2006&Theme=69&VID=0&VNAMEE=&VNAMEF=

Table 5 - Natural Gas Savings

Program	Applicable Customer Group	Base Flow Rate	Efficient Measure Flow Rate	Annual Gas Savings (m^3)	Lifetime Gas Savings (m^3)
EG TAPS	Standard Res	2.45	1.25	50	502
EG TAPS	Standard Res	3.07	1.25	82	815
EG Low-Income	LIA	2.45	1.25	50	502
EG Low-Income	LIA	3.07	1.25	82	815
EG ESK (New Only)	Standard Res	2.50	1.25	53	526
EG ESK (New Only)	Standard Res	2.50	1.50	43	433
EG ESK (New Only)	Standard Res	2.50	1.25 & 1.5*	48	480
EG MF (New Only)	Multi-Family	2.50	1.25	36	358
EG MF (New Only)	Multi-Family	2.50	1.50	29	294
EG MF	Multi-Family	2.25	1.50	21	215
EG MF	Multi-Family	2.80	1.50	40	395
EG MF	Multi-Family	3.30	1.50	58	576
EG MF	Multi-Family	3.60	1.50	69	692

** Participants in Enbridge's ESK program receive both a 1.25 and 1.5 GPM showerhead. Navigant has assumed that both are used equally and that resultant household savings are equivalent to the average savings of a household that receives only 1.5 GPM showerheads and a household that receives only 1.25 GPM showerheads. Enbridge has indicated that in the future new households may receive either only 1.5 or 1.25 GPM showerheads. These households would attain the corresponding savings shown above.*

Annual Electricity Savings	**0 kWh**

N/A

Annual Water Savings	**5,931 – 23,374 L**

Since the SAS report did not look at water savings, Navigant Consulting proposes the following method for calculating resulting water savings:

Assumptions and inputs:

- As-used flow rate with base and efficient equipment:

Base Technology	
Nominal GPM	As-Used GPM
2.45	2.02
3.07	2.35
2.5	2.05
2.25	1.91
2.8	2.21
3.3	2.48
3.6	2.64

Efficient Technology	
Nominal GPM	As-Used GPM
1.25	1.25
1.5	1.50

- Average household size: 3.1 persons (Standard Res and LIA)[10], 2.09 persons (Multi-family)[11]

[10] Summit Blue (2008).

[11] To maintain consistency with Summit Blue number but to reflect the fact that apartments are generally occupied by fewer people than houses, the Summit Blue number was degraded by the ratio of the average number of inhabitants per apartment (1.96) to the average number of inhabitants of a fully detached house in Ontario (2.9). Statistics Canada. No date. *Structural Type of Dwelling (10) and Household Size (9) for Occupied Private Dwellings of Canada, Provinces, Territories, Census Metropolitan Areas and*

- Showers per capita per day: 0.75[12]
- Average showering time per capita per day with base and efficient equipment[13]:

Base Technology As-Used GPM	Base Technology Showering Time
2.02	7.28
2.35	7.13
2.05	7.27
1.91	7.33
2.21	7.20
2.48	7.08
2.64	7.01

Efficient Technology As-Used GPM	Efficient Technology Showering Time
1.25	7.62
1.5	7.51

Annual water savings calculated as follows:

$$Savings = Ppl * Sh * 365 * \left(T_{base} * Fl_{base} - T_{eff} * Fl_{eff}\right)$$

Where:

Ppl = Number of people per household
Sh = Showers per capita per day
365 = Days per year
T_{base} = Showering time with base equipment (minutes)
T_{eff} = Showering time with efficient equipment (minutes)
Fl_{base} = As-used flow rate with base equipment (GPM)
Fl_{eff} = As-used flow rate with efficient equipment (GPM)

Census Agglomerations, 2006 Census - 100% Data (Table) *Census 2006.* Last updated Dec 6, 2008. http://www12.statcan.ca/english/census06/data/topics/RetrieveProductTable.cfm?ALEVEL=3&APATH=3&CATNO=&DETAIL=0&DIM=&DS=99&FL=0&FREE=0&GAL=0&GC=99&GID=837983&GK=NA&GRP=1&IPS=&METH=0&ORDER=1&PID=89071&PTYPE=88971&RL=0&S=1&SUB=0&ShowAll=No&StartRow=1&Temporal=2006&Theme=69&VID=0&VNAMEE=&VNAMEF=

[12] Summit Blue (2008), based on data from: Resource Management Strategies, Inc., Regional Municipality of York Water Efficiency Master Plan Update, April 2007

[13] Relationship modeled as: Average shower length = 8.17 – 0.448 * as-used GPM. From Energy Center of Wisconsin Analysis of data from Resource Management Strategies, Inc., *Regional Municipality of York Water Efficiency Master Plan Update,* April 2007. Cited in Summit Blue (2008)

Table 6 - Annual Water Savings

Program	Applicable Customer Group	Base Flow Rate	Efficient Measure Flow Rate	Base Flow Rate (as-used)	Efficient Measure Flow Rate (as-used)	Annual Water Savings (L)	Lifetime Water Savings (L)
EG TAPS	Standard Res	2.45	1.25	2.02	1.25	16,631	166,309
EG TAPS	Standard Res	3.07	1.25	2.35	1.25	23,374	233,744
EG Low-Income	LIA	2.45	1.25	2.02	1.25	16,631	166,309
EG Low-Income	LIA	3.07	1.25	2.35	1.25	23,374	233,744
EG ESK (New Only)	Standard Res	2.50	1.25	2.05	1.25	17,187	171,866
EG ESK (New Only)	Standard Res	2.50	1.50	2.05	1.50	11,596	115,958
EG ESK (New Only)	Standard Res	2.50	1.25 & 1.5*	2.05	1.38	14,391	143,912
EG MF (New Only)	Multi-Family	2.50	1.25	2.05	1.25	11,587	115,871
EG MF (New Only)	Multi-Family	2.50	1.50	2.05	1.50	7,818	78,178
EG MF	Multi-Family	2.25	1.50	1.91	1.50	5,931	59,307
EG MF	Multi-Family	2.80	1.50	2.21	1.50	10,036	100,362
EG MF	Multi-Family	3.30	1.50	2.48	1.50	13,621	136,214
EG MF	Multi-Family	3.60	1.50	2.64	1.50	15,705	157,054

** Participants in Enbridge's ESK program receive both a 1.25 and 1.5 GPM showerhead. Navigant has assumed that both are used equally and that resultant household savings are equivalent to the average savings of a household that receives only 1.5 GPM showerheads and a household that receives only 1.25 GPM showerheads. Enbridge has indicated that in the future new households may receive either only 1.5 or 1.25 GPM showerheads. These households would attain the corresponding savings shown above.*

Other Input Assumptions

Effective Useful Life (EUL)	10 Years
Summit Blue (2008) suggests an EUL of 10 years based on a survey of five studies of showerheads in other jurisdictions (California – two studies, New England, Vermont, Arkansas).	
Incremental Costs	**EG TAPS 1.25 GPM = $19.00** **EG LI 1.25 GPM = $18.71** **EG ESK 1.25 GPM = $4.26** **EG ESK 1.5 GPM = $12.50** **EG ESK 1.5 & 1.25 GPM = $16.76** **EG Multi-Fam 1.5 GPM = $12.50** **EG Multi-Fam 1.25 GPM = $12.50**
Incremental cost for EG TAPS, ESK, LI and Multi-Family based on utility bulk purchase costs.	

Pipe Wrap (R-4)

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description

Insulated hot water pipe for conventional gas storage tank-type hot water heater (R-4).

Base Equipment and Technologies Description

Conventional gas storage tank-type hot water heater without pipe wrap (R-1).

Decision Type	Target Market(s)	End Use
Retrofit	Residential (Existing)	Water heating

Codes, Standards, and Regulations

N/A

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	18	0	0	2	0
2	18	0	0	0	0
3	18	0	0	0	0
4	18	0	0	0	0
5	18	0	0	0	0
6	18	0	0	0	0
7	18	0	0	0	0
8	18	0	0	0	0
9	18	0	0	0	0
10	18	0	0	0	0
TOTALS	**180**	**0**	**0**	**2**	

Resource Savings Assumptions

Annual Natural Gas Savings	18 m^3

Assumptions and inputs:

- Gas savings calculated using method set out in 2006 Massachusetts study[1] except where noted.
- Average water heater recovery efficiency: 0.76[2]
- Average household size: 3.1 persons[3]
- Assumed diameter of pipe to be wrapped: 0.75 inches
- Length of pipe to be wrapped: 6 feet.
- Surface area of pipe to be wrapped: 1.18 square feet.
- Ambient temperature around pipes: 16 ^{o}C (60 ^{o}F) [4]
- Average water heater set point temperature: 54 ^{o}C (130 ^{o}F)[5]
- Hot water temperature in outlet pipe: 52 ^{o}C (125 ^{o}F)[6]

Annual gas savings calculated as follows:

$$Savings = \left(\frac{1}{R_{base}} - \frac{1}{R_{eff}} \right) * Sa * \left(T_{pipe} - T_{amb} \right) * 24 * 365 * \frac{1}{EF} * 10^{-6} * 27.8$$

Where:

R_{base} = R-value of base equipment
R_{eff} = R-value of efficient equipment
Sa = Surface area of outlet pipe (ft^2)
T_{pipe} = Temperature of water in outlet pipe (^{o}F)
T_{amb} = Ambient temperature around pipe (^{o}F)
24 = Hours per day
365 = Days per year
EF = Water heater energy factor
10^{-6} = Factor to convert Btu to MMBtu
27.8 = Factor to convert MMBtu to m^3

Gas savings were determined to be 75% over base measure

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[1] RLW Analytics, *Final Market Potential Report Of Massachusetts Owner Occupied 1-4 Unit Dwellings*, July 2006
http://www.cee1.org/eval/db_pdf/575.pdf
[2] Assumption used by Energy Center of Wisconsin, citing GAMA,
Pigg, Scott, *Water Heater Savings* Calculator, 2003 , www.doa.state.wi.us/docs_view2.asp?docid=2249
[3] Summit Blue, *Resource Savings Values in Selected Residential DSM Prescriptive Programs*, June 2008.
[4] RLW Analytics (2006). Given geographic proximity, Massachusetts temperatures used unchanged for Ontario.
[5] As suggested by NRCan: http://oee.nrcan.gc.ca/residential/personal/new-homes/water-conservation.cfm?attr=4
[6] From source: "It is common to find a 5 - 10 F temperature drop from the water heater to the furthest fixtures in the house." Chinnery, G. *Policy recommendations for the HERS Community to consider regarding HERS scoring credit due to enhanced effective energy factors of water heaters resulting from volumetric hot water savings due to conservation devices/strategies,* EPA Energy Star for Homes, Sept 2006
http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/Volumetric_Hot_Water_Savings_Guidelines.pdf

$$PercentSavings = \frac{(G_{base} - G_{eff})}{G_{base}}$$

Where:

G_{eff} = Annual natural gas use with efficient equipment, 8 m^3
G_{base} = Annual natural gas use with base equipment, 33 m^3

Annual Electricity Savings	0 kWh
N/A	
Annual Water Savings	**0 L**
Navigant has assumed that adopting the measure would not affect the quantity of water consumed.	

Other Input Assumptions

Effective Useful Life (EUL)	10 Years
Based on the estimated measure lifetimes used in four other jurisdictions (Iowa - 15 years, Puget Sound Energy - 10 years, Efficiency Vermont – 10 years, and NYSERDA[7] – 10 years) Navigant recommends using an EUL of 10 years.	
Base & Incremental Conservation Measure Equipment and O&M Costs	**2 $**
Average equipment cost (for six feet of pipe wrap) based on communication with local hardware stores. This does not include installation costs.	
Customer Payback Period (Natural Gas Only)[8]	**0.2 Years**
Using an 5-year average commodity cost (avoided cost)[9] of \$0.38 / m^3 and an average residential distribution cost[10] of \$0.14 / m^3, the payback period for natural gas savings is determined to be 0.2 years, based on the following: Payback Period = Incremental cost / (natural gas savings x natural gas cost) = \$2/ (18 m^3/year * \$0.52 / m^3) = 0.2 years	
Market Penetration	**47%**
Based on previous research conducted for the OPA, Navigant Consulting estimates penetration of this measure to be 47%[11].	

[7] NYSERDA, New York Energy Smart Programs, *Deemed Savings Database*
[8] Customer payback period has been calculated using natural gas savings only. Where applicable, payback period is expected to decrease when electricity and/or water savings are included.
[9] 2009 Avoided gas cost provided by Union Gas. 5 year average avoided gas cost determined by taking average for baseload and weather sensitive avoided gas cost.
[10] Average distribution cost taken calculated from both Union Gas website (http://www.uniongas.com/residential/rates/) and Enbridge Gas websites (https://portal-plumprod.cgc.enbridge.com/portal/server.pt?open=512&objID=248&PageID=0&cached=true&mode=2&userID=2).
[11] Navigant Consulting, Inc. for the Ontario Power Authority, *Residential Rebate Program: Participation Forecast and Incentive Bundling Strategy – Key Findings Summary*, December 2008

Measure Assumptions Used by Other Jurisdictions

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
State of Iowa Utilities Board[12]	21	15	113 US$	52%

Comments
For addition of R-4 insulation to previously un-insulated pipes. Measure saves 4% of 514 m^3 required for water heating.

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
Puget Sound Energy, 2007[13]	8	10	8 US$	38%

Comments
For addition of R-4 insulation to previously un-insulated pipes. Measure saves 1% of 759 m^3 required for water heating.

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
Midwest Energy Efficiency Alliance, 2003[14]	36	N/A	N/A	10.4%

Comments
No indication given of percentage savings or base natural gas consumption for water heating.

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
Efficiency Vermont, 2006[15]	N/A	10	15 US$	N/A

Comments
Only electricity savings reported (33 kWh) for an electric hot water system. Insulation upgrade not specified. No indication given of percentage savings or base natural gas consumption for water heating.

[12] Iowa Utilities Board. Docket No. EEP-08-02 MidAmerican Energy Company. Volume IV, Appendix D, Part 1 of 2
[13] Quantec *Comprehensive Assessment of Demand-Side Resource Potentials (2008-2027)* Prepared for Puget Sound Energy
[14] Midwest Energy Efficiency Alliance, *Illinois Residential Market Analysis, Final Report*, May 12, 2003. http://www.cee1.org/eval/db_pdf/390.pdf
[15] Efficiency Vermont, *Technical Reference User Manual (TRM)*, February 2006

Program: Solar Pool Heater

***Sector**: Residential Existing Homes*

Efficient Technology & Equipment Description
Solar Panels for pool heating
Qualifier/Restriction
Old gas pool heaters must be removed to qualify
Base Technology & Equipment Description
Natural Gas Heater

Resource Savings Assumptions

Natural Gas (Updated)	**1116 m^3**
Based on Enbridge Territory Load Research results: 2007 – 14 directly metered natural gas pools = 1330 m3 2008 – 6 directly metered natural gas pools = 901m3 Average natural gas savings from a customer choosing a solar pool heater alternative = 1116 m3 (100% of natural gas pool heater use)	
Electricity	**-57 kWh**
2009 Board Approved assumption filed by Navigant April 16, 2009 page c 83	
Water	**L**

Other Input Assumptions

Equipment Life	**20 Years**
2009 Board Approved assumption filed by Navigant April 16, 2009 page c 81-84	
Incremental Cost (Contractor Installed)	**1450 $**
2009 Board Approved assumption filed by Navigant April 16, 2009 page c 83	
Free Ridership	**10 %**
NRCAN, Renewable Energy, Residential Solar Pool Heating Systems; A Buyer Guide page 3, 6	

TANKLESS WATER HEATERS

Residential New & Existing Homes

Efficient Technology & Equipment Description
Tankless water heater (EF = 0.82)
Base Technology & Equipment Description
Storage tank water heater (EF = 0.575)

Resource Savings Assumptions

Natural Gas	**130 m^3**
As approved in EB 2008-0346	
Electricity	**kWh**
Water	**N/A L**

Other Input Assumptions

Equipment Life	**18 Years**
As approved in EB 2008-0346	
Incremental Cost (Contractor Installation)	**$750**
As approved in EB 2008-0346	
Free Ridership	**2 %**
Free ridership rate will remain as filed in EB 2008-0384 & 0385.	

Low-Income Space Heating

PROGRAMMABLE THERMOSTAT

Low Income Residential Existing Homes

Efficient Technology & Equipment Description
Programmable thermostat
Base Technology & Equipment Description
Standard manual thermostat

Resource Savings Assumptions

Natural Gas (Updated)	**53 m^3**
Savings recommended by Navigant Consulting.[1]	
Electricity (Updated)	**54 kWh**
Savings recommended by Navigant Consulting.[1]	
Water	**n/a L**

Other Input Assumptions

Equipment Life	**15 years**
Equipment life recommended by Summit Blue Consulting and as approved in EB 2008-0384 & 0385.[1]	
Incremental Cost (Contr. Install) (UG/EGD)	**$69.18**
As per utility program costs.	
Free Ridership	**1 %**
As per EB 2008-0384 & 0385.	

[1] Draft Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. B-112-115, Feb. 6, 2009.

Low-Income Water Heating

1.0 GAL/MIN FAUCET AERATOR (BATHROOM)

Low Income Residential Existing Homes

Efficient Technology & Equipment Description
Faucet Aerator (Bathroom) (1.0 GPM)
Base Technology & Equipment Description
Average existing stock & Ontario Building Code 2006 maximum allowed (2.2 GPM)

Resource Savings Assumptions

Natural Gas (Updated)	**10 m^3**
Savings recommended by Navigant Consulting.[1] adjusted for 1.0 GPM	
Electricity	**n/a kWh**
Water (Updated)	**3,435 L**
Savings recommended by Navigant Consulting[1] adjusted for 1.0 GPM	

Other Input Assumptions

Equipment Life	**10 Years**
Faucet aerators have an estimated service life of 10 years.[1, 2] As approved in EB 2008-0384 & 0385.	
Incremental Cost	**.55 $**
As per utility program costs, bulk purchase of 1.0 aerators for new/existing market via Union.	
Free Ridership	**1 %**
As approved in EB 2009-0103 for 1.5 gpm aerators.	

[1] Final Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, April 16, 2009

[2] U.S. DOE – FEMP, Energy Cost Calculator for Faucets and Showerheads, http://www.eere.energy.gov/femp

1.5 GAL/MIN FAUCET AERATOR (Bathroom)

Low Income (Distributed)

Efficient Technology & Equipment Description
Faucet Aerator (Bathroom) (1.5 GPM)
Base Technology & Equipment Description
Average existing stock (2.2 GPM)

Resource Savings Assumptions

Natural Gas (Updated)	**6 m^3**
Savings recommended by Navigant Consulting.[1]	
Electricity	**n/a kWh**
Water (Updated)	**2,004 L**
Savings recommended by Navigant Consulting.[1]	

Other Input Assumptions

Equipment Life	**10 years**
Faucet aerators have an estimated service life of 10 years.[1, 2] Savings recommended by Navigant Consulting.[1]	
Incremental Cost **Customer Install**	**$.46**
As per utility program costs.	
Free Ridership	**1 %**
As per EB 2009-0103	

[1] Draft Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. B-108-111, Feb. 6, 2009.

[28] U.S. DOE – FEMP, Energy Cost Calculator for Faucets and Showerheads, http://www.eere.energy.gov/femp

1.0 GAL/MIN FAUCET AERATOR (KITCHEN)

Low Income Residential Existing Homes

Efficient Technology & Equipment Description
Faucet Aerator (Kitchen) (1.0 GPM)
Base Technology & Equipment Description
Average existing stock – 2.5 GPM Faucet Aerator (Kitchen)

Resource Savings Assumptions

Natural Gas	**35 m^3**
Savings based on Navigant's[1], except using a 1.0 GPM efficient technology case	
Electricity	**n/a kWh**
Water	**11,694 L**
Savings based on Navigant's[1], except using a 1.0 GPM efficient technology case	

Other Input Assumptions

Equipment Life	**10 years**
Faucet aerators have an estimated service life of 10 years.[2] As approved in EB 2008-0384 & 0385.	
Incremental Cost	**1.00 $**
As per utility program costs, bulk purchase of 1.0 aerators for new/existing market.	
Free Ridership	**1 %**
As approved in EB 2009-0103 for 1.5 gpm aerators	

[1] Draft Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. B-65-68, Feb. 6, 2009.

[2] U.S. DOE – FEMP, Energy Cost Calculator for Faucets and Showerheads, http://www.eere.energy.gov/femp

1.5 GAL/MIN FAUCET AERATOR (Kitchen)

Low Income (Distributed)

Efficient Technology & Equipment Description
Faucet Aerator (Kitchen) (1.5 GPM)
Base Technology & Equipment Description
Average existing stock (2.5 GPM)

Resource Savings Assumptions

Natural Gas (Updated)	**23 m^3**
Savings recommended by Navigant Consulting.[1]	
Electricity	**n/a kWh**
Water (Updated)	**7,797 L**
Savings recommended by Navigant Consulting.[1]	

Other Input Assumptions

Equipment Life	**10 years**
Faucet aerators have an estimated service life of 10 years.[1, 2] Recommended by Navigant Consulting.[1]	
Incremental Cost **Customer Install**	**$.94**
As per utility program costs.	
Free Ridership	**1 %**
As per EB 2009-0103	

[1] Draft Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. B-112-115, Feb. 6, 2009.

[2] U.S. DOE – FEMP, Energy Cost Calculator for Faucets and Showerheads, http://www.eere.energy.gov/femp

Low-Flow Showerhead (Various GPM, Enbridge TAPS, ESK and Multi-Family)

Revision #	Description/Comment	Date Revised
		September 20, 2010

Efficient Equipment and Technologies Description	
Low-flow Showerhead (1.25 or 1.5 GPM) – distributed to participants under Enbridge's TAPS program, Enbridge's ESK program, Enbridge's Multi-Family program and Enbridge's Low-Income program.	
Base Equipment and Technologies Description	
Enbridge TAPS (existing only)	– 2.45 GPM or – 3.07 GPM[1]
Enbridge ESK (new only)	– Maximum allowable by OBC (2.5 GPM)
Enbridge Multi-Family (MF) (existing only)	– 2.25 GPM – 2.8 GPM – 3.3 GPM – 3.6 GPM[2]
Enbridge Multi-Family (MF) (new only)	– Maximum allowable by OBC (2.5 GPM)
Enbridge Low-Income	– 2.45 GPM or – 3.07[3]

Decision Type	Target Market(s)	End Use
Enbridge TAPS - Existing, Enbridge ESK – New Only, Enbridge MF – New and Existing	Residential, Low-Income, Multi-family	Water heating

[1] Enbridge load research indicates that that the average bag-tested flow rate for showerheads that fall within the 2.0 – 2.5 GPM bucket is 2.45 GPM and that the average bag-tested flow rate for showerheads that fall within the >2.5 GPM bucket is 3.07.

[2] Enbridge contractors install the showerheads as part of the Enbridge Multi-Family program. The base measure is reported as falling in one of four buckets, 2.0 – 2.5 GPM, 2.6 – 3.0 GPM, 3.1 – 3.5 GPM and greater than 3.6 GPM. Navigant has assumed that in each case the average base technology GPM for each of the first three buckets is the mid-point and that the average GPM for the fourth bucket is the lowest possible value; 3.6 GPM

[3] The average GPM of low-income households' showerheads is assumed by Navigant to be no different than that of standard single family households'.

Codes, Standards, and Regulations

Ontario Building Code (2006)[4] requires shower heads to have a maximum flow of 2.5 GPM (9.5 L/min).

Resource Savings Table

Year (EUL=)	Electricity and Other Resource Savings: Natural Gas (m^3)	Electricity (kWh)	Water (L)	Equipment & O&M Costs of Conservation Measure ($)	Equipment & O&M Costs of Base Measure ($)
1	21 – 82	0	5,931 – 23,374	6	0
2	21 – 82	0	5,931 – 23,374	0	0
3	21 – 82	0	5,931 – 23,374	0	0
4	21 – 82	0	5,931 – 23,374	0	0
5	21 – 82	0	5,931 – 23,374	0	0
6	21 – 82	0	5,931 – 23,374	0	0
7	21 – 82	0	5,931 – 23,374	0	0
8	21 – 82	0	5,931 – 23,374	0	0
9	21 – 82	0	5,931 – 23,374	0	0
10	21 – 82	0	5,931 – 23,374	0	0
TOTALS	**215 - 815**	**0**	**59,307 – 233,744**	**EG TAPS 1.25 GPM = $19.00 EG LI 1.25 GPM = $18.71 EG ESK 1.25 GPM = $4.26 EG ESK 1.5 GPM = $12.50 EG ESK 1.5 & 1.25 GPM = $16.76 EG Multi-Fam 1.5 GPM = $12.50 EG Multi-Fam 1.25 GPM = $12.50**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	21 – 82 m^3

Enbridge Gas commissioned a study by the SAS Institute (Canada)[5] to estimate natural gas savings for low-flow showerheads in Enbridge territory. Data was collected August 31, 2007 until August 31, 2009 for both treatment and control groups. Low flow showerheads were installed in treatment households between August 13, 2008 and October 30, 2008. There were 54 households with low-flow showerheads and 124 households without low-flow showerheads.

To calculate the gas savings, three different models were used to analyze the gas consumption data

1) a comparison made during the same time frame (post-installation) between a control set of households[6] and households that had them installed
2) a Pre & Post installation analysis on the same households, and
3) a complex time trend model analysis that factored in many household characteristics over the whole Pre & Post time period.

All three analyses agreed well with each other.[7]

Three buckets for pre-existing showerheads were originally proposed. However, the lowest flow bucket (2.0 GPM or less) had too few observations and are rare in the population of households. The natural gas savings for the other two buckets are estimated to be as follows:

[4] Ontario Regulations 350/06, 2006 Building Code
[5] Rothman, Lorne, SAS® PHASE II Analysis for Enbridge Gas Distribution Inc.: Estimating the Impact of Low-Flow Showerhead Installation; April 5, 2010
[6] Where no low-flow showerheads were ever installed
[7] Model 1 – a blended rate of 71.3 m3/yr (only models II and II provided bucketed savings estimates)
Model 2 – a blended rate of 67.4 m3/yr (45.4 m3/yr for 2 to 2.5 GPM bucket and 87.8 m3/yr for over 2.5 GPM), and
Model 3 – a blended rate of 77.2 m3/yr (46.4 m3/yr for 2 to 2.5 GPM bucket and 87.9 m3/yr for over 2.5 GPM).

Table 1 - SAS Study Results

Bucket for Base Showerhead	Average Flow Rate of SAS Sample (GPM)	Annual Natural Gas Savings (m3)
2.0 to 2.5 GPM	2.36	46
> 2.5 GPM	3.19	88

To extrapolate the savings estimates reported in the SAS study to the base technologies under consideration several steps are required.

1. **Estimate the "as-used" flow of the base and efficient technologies.**

In its report on showerhead savings, Summit Blue[8], notes that the actual flow-rate as used in showers has been found to differ somewhat from the nominal flow-rate. Citing a 1994 California study, they provide an equation for calculating the "as-used" flow:

As-used flow rate (GPM) = 0.691 + 0.542*Nominal flow rate (GPM)

Navigant notes that applying this equation to a showerhead with a 1.25 GPM flow rate would result in an as-used flow rate that is greater than the nominal flow rate. Navigant has therefore applied a somewhat modified version of the equation above to determine the as-used flow rate. The as-used flow rate is estimated to be the minimum of either the result of the equation above or the nominal flow rate.

Applying the modified equation to Table 1, above, we obtain the following:

Table 2 - As-Used Flow

Nominal Flow (GPM)		As-Used Flow (GPM)		Delta As-Used Flow (GPM)	Observed Savings (m^3)
Base Technology	Efficient Measure	Base Technology	Efficient Measure		
2.36	1.25	1.97	1.25	0.72	46
3.19	1.25	2.42	1.25	1.17	88

2. **Estimate the average annual natural gas consumption of a 1.25 GPM showerhead.**

Based on the values above, Navigant has estimated that the annual natural gas consumption of the 1.25 GPM showerhead is 87 m^3 per year.

Table 3 - Annual Natural Gas Consumption of a 1.25 GPM Showerhead

Delta As-Used Flow (GPM)	Observed Savings (m^3)	Efficient Technology As-Used Flow (GPM)	Implied Annual Gas Consumption of Efficient Technology (m^3)	Average (m^3)
A	B	C	D = (C/A)*B	E = Average(D)
0.72	46	1.25	80	87
1.17	88	1.25	94	

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[8] Summit Blue, *Resource Savings Values in Selected Residential DSM Prescriptive Programs*, prepared for Union Gas and Enbridge Gas Distribution, June 2008

3. Extrapolate the implied annual natural gas consumption of showerheads in both buckets identified by the SAS Institute.

Extrapolating these values is simply a matter of adding the estimated savings by bucket to the estimated annual consumption of the 1.25 GPM showerhead.

Table 4 - Implied Annual Natural Gas Consumption by Showerhead Flow Rate

Nominal Flow Rate (GPM)	Implied Annual Natural Gas Consumption (m3)
1.25	87
2.36	133
3.19	175

4. Estimate an equation from which the annual natural gas consumption of showerheads with flow rates different to those above may be extrapolated.

Fitting a polynomial equation to the three data-points in Table 4 above delivers the following equation which may be used to extrapolate the annual natural gas consumption of a given showerhead:

$$y = 49.06 + 24.39x + 4.72x^2$$

Where:

y = Annual natural gas consumption (m^3)
x = Nominal GPM of showerhead

Navigant notes that given the manner in which this equation was derived, and the values of the parameters, it may be inappropriate to use this equation to extrapolate the annual natural gas consumption of showerheads with a nominal flow rate that is less than 1.25 GPM.

In multi-family homes, Navigant has adjusted savings based on number of occupants per household to reflect differences in patterns of use. The adjustment factor is the fraction of average number of occupants per household in an apartment building over the average number of occupants per household in a single-detached house[9]. This factor is (2/2.9) = 69% for buildings over 5 stories and (1.9/2.9) = 66% for buildings of five stories or less. The average of these two factors, weighted by the number of each type of household is 68%.

It should be noted that the savings below are per household and predicated on the assumption that all showers taken in that household are taken using a shower with the low-flow showerhead. In the program measurement and verification stage, Enbridge will undertake to determine what proportion of showers per household were taken with the efficient measure and apply this factor to previously calculated savings.

[9] Statistics Canada. *Structural Type of Dwelling (10) and Household Size (9) for Occupied Private Dwellings of Canada, Provinces, Territories, Census Metropolitan Areas and Census Agglomerations, 2006 Census - 100% Data* (Table) *Census 2006.* Last updated Dec 6, 2008.
http://www12.statcan.ca/english/census06/data/topics/RetrieveProductTable.cfm?ALEVEL=3&APATH=3&CATNO=&DETAIL=0&DIM=&DS=99&FL=0&FREE=0&GAL=0&GC=99&GID=837983&GK=NA&GRP=1&IPS=&METH=0&ORDER=1&PID=89071&PTYPE=88971&RL=0&S=1&SUB=0&ShowAll=No&StartRow=1&Temporal=2006&Theme=69&VID=0&VNAMEE=&VNAMEF=

Table 5 - Natural Gas Savings

Program	Applicable Customer Group	Base Flow Rate	Efficient Measure Flow Rate	Annual Gas Savings (m^3)	Lifetime Gas Savings (m^3)
EG TAPS	Standard Res	2.45	1.25	50	502
EG TAPS	Standard Res	3.07	1.25	82	815
EG Low-Income	LIA	2.45	1.25	50	502
EG Low-Income	LIA	3.07	1.25	82	815
EG ESK (New Only)	Standard Res	2.50	1.25	53	526
EG ESK (New Only)	Standard Res	2.50	1.50	43	433
EG ESK (New Only)	Standard Res	2.50	1.25 & 1.5*	48	480
EG MF (New Only)	Multi-Family	2.50	1.25	36	358
EG MF (New Only)	Multi-Family	2.50	1.50	29	294
EG MF	Multi-Family	2.25	1.50	21	215
EG MF	Multi-Family	2.80	1.50	40	395
EG MF	Multi-Family	3.30	1.50	58	576
EG MF	Multi-Family	3.60	1.50	69	692

** Participants in Enbridge's ESK program receive both a 1.25 and 1.5 GPM showerhead. Navigant has assumed that both are used equally and that resultant household savings are equivalent to the average savings of a household that receives only 1.5 GPM showerheads and a household that receives only 1.25 GPM showerheads. Enbridge has indicated that in the future new households may receive either only 1.5 or 1.25 GPM showerheads. These households would attain the corresponding savings shown above.*

Annual Electricity Savings	**0 kWh**

N/A

Annual Water Savings	**5,931 – 23,374 L**

Since the SAS report did not look at water savings, Navigant Consulting proposes the following method for calculating resulting water savings:

Assumptions and inputs:

- As-used flow rate with base and efficient equipment:

Base Technology	
Nominal GPM	As-Used GPM
2.45	2.02
3.07	2.35
2.5	2.05
2.25	1.91
2.8	2.21
3.3	2.48
3.6	2.64

Efficient Technology	
Nominal GPM	As-Used GPM
1.25	1.25
1.5	1.50

- Average household size: 3.1 persons (Standard Res and LIA)[10], 2.09 persons (Multi-family)[11]

[10] Summit Blue (2008).

[11] To maintain consistency with Summit Blue number but to reflect the fact that apartments are generally occupied by fewer people than houses, the Summit Blue number was degraded by the ratio of the average number of inhabitants per apartment (1.96) to the average number of inhabitants of a fully detached house in Ontario (2.9). Statistics Canada. No date. *Structural Type of Dwelling (10) and Household Size (9) for Occupied Private Dwellings of Canada, Provinces, Territories, Census Metropolitan Areas and*

- Showers per capita per day: 0.75[12]
- Average showering time per capita per day with base and efficient equipment[13]:

Base Technology	
As-Used GPM	Showering Time
2.02	7.28
2.35	7.13
2.05	7.27
1.91	7.33
2.21	7.20
2.48	7.08
2.64	7.01

Efficient Technology	
As-Used GPM	Showering Time
1.25	7.62
1.5	7.51

Annual water savings calculated as follows:

$$Savings = Ppl * Sh * 365 * \left(T_{base} * Fl_{base} - T_{eff} * Fl_{eff}\right)$$

Where:

Ppl = Number of people per household
Sh = Showers per capita per day
365 = Days per year
T_{base} = Showering time with base equipment (minutes)
T_{eff} = Showering time with efficient equipment (minutes)
Fl_{base} = As-used flow rate with base equipment (GPM)
Fl_{eff} = As-used flow rate with efficient equipment (GPM)

Census Agglomerations, 2006 Census - 100% Data (Table) *Census 2006.* Last updated Dec 6, 2008.
http://www12.statcan.ca/english/census06/data/topics/RetrieveProductTable.cfm?ALEVEL=3&APATH=3&CATNO=&DETAIL=0&DIM=&DS=99&FL=0&FREE=0&GAL=0&GC=99&GID=837983&GK=NA&GRP=1&IPS=&METH=0&ORDER=1&PID=89071&PTYPE=88971&RL=0&S=1&SUB=0&ShowAll=No&StartRow=1&Temporal=2006&Theme=69&VID=0&VNAMEE=&VNAMEF=

[12] Summit Blue (2008), based on data from: Resource Management Strategies, Inc., Regional Municipality of York Water Efficiency Master Plan Update, April 2007

[13] Relationship modeled as: Average shower length = 8.17 – 0.448 * as-used GPM. From Energy Center of Wisconsin Analysis of data from Resource Management Strategies, Inc., *Regional Municipality of York Water Efficiency Master Plan Update,* April 2007. Cited in Summit Blue (2008)

Table 6 - Annual Water Savings

Program	Applicable Customer Group	Base Flow Rate	Efficient Measure Flow Rate	Base Flow Rate (as-used)	Efficient Measure Flow Rate (as-used)	Annual Water Savings (L)	Lifetime Water Savings (L)
EG TAPS	Standard Res	2.45	1.25	2.02	1.25	16,631	166,309
EG TAPS	Standard Res	3.07	1.25	2.35	1.25	23,374	233,744
EG Low-Income	LIA	2.45	1.25	2.02	1.25	16,631	166,309
EG Low-Income	LIA	3.07	1.25	2.35	1.25	23,374	233,744
EG ESK (New Only)	Standard Res	2.50	1.25	2.05	1.25	17,187	171,866
EG ESK (New Only)	Standard Res	2.50	1.50	2.05	1.50	11,596	115,958
EG ESK (New Only)	Standard Res	2.50	1.25 & 1.5*	2.05	1.38	14,391	143,912
EG MF (New Only)	Multi-Family	2.50	1.25	2.05	1.25	11,587	115,871
EG MF (New Only)	Multi-Family	2.50	1.50	2.05	1.50	7,818	78,178
EG MF	Multi-Family	2.25	1.50	1.91	1.50	5,931	59,307
EG MF	Multi-Family	2.80	1.50	2.21	1.50	10,036	100,362
EG MF	Multi-Family	3.30	1.50	2.48	1.50	13,621	136,214
EG MF	Multi-Family	3.60	1.50	2.64	1.50	15,705	157,054

** Participants in Enbridge's ESK program receive both a 1.25 and 1.5 GPM showerhead. Navigant has assumed that both are used equally and that resultant household savings are equivalent to the average savings of a household that receives only 1.5 GPM showerheads and a household that receives only 1.25 GPM showerheads. Enbridge has indicated that in the future new households may receive either only 1.5 or 1.25 GPM showerheads. These households would attain the corresponding savings shown above.*

Other Input Assumptions

Effective Useful Life (EUL)	10 Years
Summit Blue (2008) suggests an EUL of 10 years based on a survey of five studies of showerheads in other jurisdictions (California – two studies, New England, Vermont, Arkansas).	
Incremental Costs	**EG TAPS 1.25 GPM = $19.00** **EG LI 1.25 GPM = $18.71** **EG ESK 1.25 GPM = $4.26** **EG ESK 1.5 GPM = $12.50** **EG ESK 1.5 & 1.25 GPM = $16.76** **EG Multi-Fam 1.5 GPM = $12.50** **EG Multi-Fam 1.25 GPM = $12.50**
Incremental cost for EG TAPS, ESK, LI and Multi-Family based on utility bulk purchase costs.	

Commercial Cooking

Energy Star Fryers

Commercial – New/Existing, EGD & UG

Efficient Technology & Equipment Description
Energy Star Fryer
Qualifier/Restriction
No restriction
Base Technology & Equipment Description
Standard-efficiency fryer:

Resource Savings Assumptions

Natural Gas	**1,083 m³**

The gas savings were based on FSTC's calculator,[1] updated by studies conducted by NGTC including a survey of facilities in UG territory, using the inputs below. [2,3,4]

	Fryers	Inputs		Source
	Definitions	**Base**	**HE**	
Nb_{days}	Number of operating days per year	365	365	FSTC Life cycle calculator
Er_i	Idle energy rate (Btu/hr)	14,000	9,000	
N_p	Number of preheats per day	1	1	
E_p	Preheat energy (Btu)	16,000	15,500	
E_{food}	Energy transferred to food (Btu/lb)	565	565	
P_{hr}	Production capacity (lbs/hr)	60	65	
Eff	Cooking efficiency	35%	50%	

[1] Food Service Technology Center – Life-Cycle and Energy Cost Calculators - http://www.fishnick.com/saveenergy/tools/calculators/, visited in the fall of 2010
[2] NGTC, DSM Opportunities Associated with Gas-Fired Food Service Equipment, Final Report, Ver 2, June 22, 2010
[3] NGTC, Phase 3-jan14 2011 steamer corrected.xlsx
[4] NGTC,Characterizing the Demand-Side Management Potential of Gas-Fired Commercial Food Service Equipment. 2006

Prod	Daily production (lbs/day)	100	100	NGTC 2006 report, corroborated by fryer load data in UG territory (FSTC calculator has 150 lbs/day).
$Elec_p$	Electricity consumption for preheat (kWh)	0.07	0.07	Average values from technical specifications from various manufacturers
P_i	Electric power in idle mode (kW)	0.13	0.13	
P_h	Electric power in heavy load mode (kW)	0.41	0.41	
n%	Used to calculate time in idle mode on UG territory	84%	85%	% of time in idle mode based on results of NGTC telephone survey of full service restaurants, limited service restaurants and institutional establishments (schools, colleges, universities and hospitals) on UG territory
t_{daily}	Number of operating hours per day (hrs)	12	12	Based on NGTC telephone survey
t_p	Preheat time (hrs)	0.175	0.175	Based on FSTC appliance test reports for fryers
t_i	Hours per day in idle mode (hrs)	9.933	10.099	Calculated from $t_i = n\% * (t_{daily} - t_p)$
t_h	Time in heavy load mode, i.e. cooking time (hrs)	1.892	1.726	Calculated from $t_h = t_{daily} - (t_p + t_i)$
E_h	Daily heavy-load natural gas consumption (Btu)	Calculated		
E_i	Daily idle natural gas consumption (Btu)	Calculated		
E_{annual}	Annual natural gas consumption (Btu/year)	Calculated		

$$Savings = Nb_{days} * \left[E_{food} * \left(\frac{P_{hr_{base}} * t_{h_{base}}}{Eff_{base}} - \frac{P_{hr_{HE}} * t_{h_{HE}}}{Eff_{HE}}\right) + \left(Er_{i_{base}} * t_{i_{base}} - Er_{i_{HE}} * t_{i_{HE}}\right) + N_p * \left(E_{p_{base}} - E_{p_{HE}}\right)\right]$$

Electricity	**17 kWh**
$Elec_{savings} = Nb_{days} * \left[\left(t_{i_{base}} - t_{i_{HE}}\right) * P_i + \left(t_{h_{base}} - t_{h_{HE}}\right) * P_h\right]$ Electrical savings are based on the inputs above.	
Water	**0 L**
None	

Other Input Assumptions

Equipment Life	**12 Years**
Savings attributed to the measures are expected to last the life expectancy of the equipment. Source of effective useful life: FSTC savings calculator as referenced in NGTC, DSM OPPORTUNITIES ASSOCIATED WITH GAS-FIRED FOOD SERVICE EQUIPMENT, Final Report Ver 2, April 20, 2010.	
Incremental Cost	**$ 1,028**
High-efficiency and standard-efficiency equipment (base case) purchase prices were obtained from list prices in Canadian dollars obtained from Ontarian distributors. High-efficiency price and base case prices are for Pitco comparables (Source for list prices: W.D. College). Base Case cost - $6,400 Upgrade cost - $7,428 Installation costs of high-efficiency and standard-efficiency equipment are considered to be identical. Similarly, maintenance costs of high-efficiency and standard-efficiency equipment are considered to be identical (Source: W.D. College). Hence, the installation and maintenance costs were not taken into account in the resource savings table[5].	

[5] NGTC, "DSM Opportunities Associated with Gas-Fired Food Service Equipment", Final Report, Ver 2, June 22, 2010, pg 9

Energy Star Convection Ovens (Full Size)

Commercial – New/Existing, EGD & UG

Efficient Technology & Equipment Description
Energy Star convection oven.
Qualifier/Restriction
No restriction
Base Technology & Equipment Description
Standard-efficiency convection oven. Model used for savings calculation corresponds to default FSTC calculator full size standard-efficiency convection oven

Resource Savings Assumptions

Natural Gas	**847 m^3**

The gas savings were based on FSTC's calculator, [11] updated by studies conducted by NGTC including a survey of facilities in UG territory, using the inputs below. [12,13,14]

	Convection ovens (full size)	**Inputs**		**Source**
	Definitions	**Base**	**HE**	
Nb_{days}	Number of operating days per year	365	365	FSTC Life cycle calculator
Er_i	Idle energy rate (Btu/hr)	18,000	13,000	
N_p	Number of preheats per day	1	1	
E_p	Preheat energy (Btu)	19,000	11,000	
E_{food}	Energy transferred to food (Btu/lb)	250	250	
P_{hr}	Production capacity (lbs/hr)	70	80	
Eff	Cooking efficiency	30%	44%	
Prod	Daily	100	100	

[11] Food Service Technology Center – Life-Cycle and Energy Cost Calculators - http://www.fishnick.com/saveenergy/tools/calculators/, visited in the fall of 2010

[12] NGTC, DSM Opportunities Associated with Gas-Fired Food Service Equipment, Final Report, Ver 2, June 22, 2010

[13] NGTC, Phase 3-jan14 2011 steamer corrected.xlsx

[14] NGTC,Characterizing the Demand-Side Management Potential of Gas-Fired Commercial Food Service Equipment. 2006

	production (lbs/day)			
$Elec_p$	Electricity consumption for preheat (kWh)	0.41	0.41	Average values from technical specifications from various manufacturers
P_i	Electric power in idle mode (kW)	0.54	0.54	
P_h	Electric power in heavy load mode (kW)	0.55	0.55	
$n\%$	Used to calculate time in idle mode on UG territory	88%	89%	% of time in idle mode based on results of NGTC telephone survey of full service restaurants, limited service restaurants and institutional establishments (schools, colleges, universities and hospitals) on UG territory
t_{daily}	Number of operating hours per day (hrs)	12	12	Based on NGTC telephone survey
t_p	Preheat time (hrs)	0.4	0.4	Based on FSTC appliance test reports for convection ovens
t_i	Hours per day in idle mode (hrs)	10.171	10.324	Calculated from $t_i = n\% * (t_{daily} - t_p)$
t_h	Time in heavy load mode, i.e. cooking time (hrs)	1.429	1.276	Calculated from $t_h = t_{daily} - (t_p + t_i)$
E_h	Daily heavy-load natural gas consumption (Btu)	Calculated values		
E_i	Daily idle natural gas consumption (Btu)	Calculated values		
E_{annual}	Annual natural gas consumption (Btu/year)	Calculated		

$$Savings = Nb_{days} * \left[E_{food} * \left(\frac{P_{hr_{base}} * t_{h_{base}}}{Eff_{base}} - \frac{P_{hr_{HE}} * t_{h_{HE}}}{Eff_{HE}}\right) + \left(Er_{i_{base}} * t_{i_{base}} - Er_{i_{HE}} * t_{i_{HE}}\right) + N_p * \left(E_{p_{base}} - E_{p_{HE}}\right)\right]$$

Electricity	1 kWh
$Elec_{savings} = Nb_{days} * \left[\left(t_{i_{base}} - t_{i_{HE}}\right) * P_i + \left(t_{h_{base}} - t_{h_{HE}}\right) * P_h\right]$	
Water	**0 L**
None	

Other Input Assumptions

Equipment Life	12 Years
Savings attributed to the measures are expected to last the life expectancy of the equipment. Source of effective useful life: FSTC savings calculator as referenced in NGTC, DSM OPPORTUNITIES ASSOCIATED WITH GAS-FIRED FOOD SERVICE EQUIPMENT, Final Report Ver. 2, April 20, 2010.	
Incremental Cost	**$ 875**
Incremental costs are estimated using US list prices divided by 1.3, based on ratio of US and Canadian list prices for comparable Vulcan and Lang models, respectively. Installation costs of high-efficiency and standard-efficiency equipment are considered to be identical. Similarly, maintenance costs of high-efficiency and standard-efficiency equipment are considered to be identical (Source: W.D. College). Hence, the installation and maintenance costs were not taken into account[15].	

[15] NGTC, "DSM Opportunities Associated with Gas-Fired Food Service Equipment", Final Report, Ver 2, June 22, 2010, pg 9

Energy Star Steam Cookers

Commercial – New/Existing, EGD & UG

Efficient Technology & Equipment Description
Energy Star steam cooker.
Qualifier/Restriction
No restriction
Base Technology & Equipment Description
Standard-efficiency steam cooker: Model used for savings calculations corresponds to the FSTC default standard-efficiency 3-pan model.

Resource Savings Assumptions

Natural Gas	3,224 m^3

The gas savings were based on FSTC's calculator, [16] updated by studies conducted by NGTC including a survey of facilities in UG territory, using the inputs below. [17,18,19]

	Steamers	Inputs		Source
	Definitions	**Base**	**HE**	
Nb_{days}	Number of operating days per year	365	365	FSTC Life cycle calculator
Er_i	Idle energy rate (Btu/hr)	11,000	6,250	
N_p	Number of preheats per day	1	1	
E_p	Preheat energy (Btu)	18,000	7,000	
E_{food}	Energy transferred to food (Btu/lb)	107	107	
P_{hr}	Production capacity (lbs/hr)	50	55	
Eff	Cooking efficiency	15%	38%	
Prod	Daily production (lbs/day)	100	100	

[16] Food Service Technology Center – Life-Cycle and Energy Cost Calculators - http://www.fishnick.com/saveenergy/tools/calculators/, visited in the fall of 2010
[17] NGTC, DSM Opportunities Associated with Gas-Fired Food Service Equipment, Final Report, Ver 2, June 22, 2010
[18] NGTC, Phase 3-jan14 2011 steamer corrected.xlsx
[19] NGTC,Characterizing the Demand-Side Management Potential of Gas-Fired Commercial Food Service Equipment. 2006

$Elec_p$	Electricity consumption for preheat (kWh)	0.03	0.03	Average values from technical specifications from various manufacturers
P_i	Electric power in idle mode (kW)	0.02	0.02	
P_h	Electric power in heavy load mode (kW)	0.07	0.07	
gph	Hourly water consumption (gal/hr)	40	3	FSTC Life cycle calculator
n%	Used to calculate time in idle mode in UG territory	--	85%	% of time in idle mode based on results of NGTC telephone survey of full service restaurants, limited service restaurants and institutional establishments (schools, colleges, universities and hospitals) on UG territory
t_{daily}	Number of operating hours per day (hrs)	12	12	Based on NGTC telephone survey
t_p	Preheat time (hrs)	0.17	0.17	Based on FSTC appliance test reports for steamers
t_i	Hours per day in idle mode (hrs)	1.183	9.996	Calculated from $t_i = \left(t_{daily} - t_p\right) * 0{,}1$ for LE, and from $t_i = n\% * (t_{daily} - t_p)$ for HE.
t_h	Time in heavy load mode, i.e. cooking time (hrs)	10.647	1.834	Calculated from $t_h = \left(t_{daily} - t_p\right) * 0{,}9$ for LE and from $t_h = t_{daily} - (t_p + t_i)$ for HE. Note: LE steamers operate in constant steam mode (energy consumption equivalent to heavy load mode), 90% of the time (Reference: FSTC).
lpg	Conversion factor: liter per gallon (3,785)			
E_h	Daily heavy-load natural gas consumption (Btu)	Calculated values		
E_i	Daily idle natural gas consumption	Calculated values		

	(Btu)	
E_{annual}	Annual natural gas consumption (Btu/year)	Calculated
W_{annual}	Annual water consumption (L/year)	Calculated
$W_{savings}$	Annual water savings (L/year)	Calculated

$$Savings = Nb_{days} * \left[E_{food} * \left(\frac{P_{hr_{base}} * \left(t_{daily} - t_p\right) * 0{,}9}{Eff_{base}} - \frac{P_{hr_{HE}} * t_{h_{HE}}}{Eff_{HE}}\right) + \left(Er_{i_{base}} * \left(t_{daily} - t_p\right) * 0{,}1 - Er_{i_{HE}} * t_{i_{HE}}\right) + N_p * \left(E_{p_{base}} - E_{p_{HE}}\right)\right]$$

Electricity	**162 kWh**
$Elec_{savings} = Nb_{days} * \left[\left(t_{i_{base}} - t_{i_{HE}}\right) * P_i + \left(t_{h_{base}} - t_{h_{HE}}\right) * P_h\right]$	
Water	**42,812 L**
$W_{savings} = Nb_{days} * t_{daily} * \frac{(gph_{base} - gph_{HE})}{lpg}$	

Other Input Assumptions

Equipment Life	**10 Years**
Savings attributed to the measures are expected to last the life expectancy of the equipment. Source of effective useful life: FSTC savings calculator as referenced in NGTC, DSM OPPORTUNITIES ASSOCIATED WITH GAS-FIRED FOOD SERVICE EQUIPMENT, Final Report Ver 2, April 20, 2010.	
Incremental Cost	**$ 2,000**
Too many discrepancies between standard-efficiency and high-efficiency Canadian list prices were observed to be able to give price estimates. Instead, the estimated incremental cost from The Berkshire Gas Company, D.P.U. 09-124 Technical Reference Manual for GasNetworks Measures: NYSERDA Deemed Savings Data (June 2009) is used. Canadian and US price increments are assumed to be identical. Installation costs of high-efficiency and standard-efficiency equipment are considered to be identical. Similarly, maintenance costs of high-efficiency and standard-efficiency equipment are considered to be identical (Source: W.D. College). Hence, the installation and maintenance costs were not taken into account[20].	

[20] NGTC, "DSM Opportunities Associated with Gas-Fired Food Service Equipment", Final Report, Ver 2, June 22, 2010, pg 9

High Efficiency Under-Fired Broilers

Commercial – New/Existing, EGD & UG

Efficient Technology & Equipment Description
High-efficiency broiler: Minimum 34% efficiency. In case of the 36" versions: Maximum Idle energy rate: 65,000 Btu/hr
Qualifier/Restriction
No restriction
Base Technology & Equipment Description
Standard-efficiency broiler: (FSTC calculator default broiler type)

Resource Savings Assumptions

Natural Gas	**1,677 m^3**

The gas savings were based on FSTC's calculator, [6] updated by studies conducted by NGTC including a survey of facilities in UG territory, using the inputs below. [7,8,9]

	Broilers	**Inputs**		**Source**
	Definitions	**Base**	**HE**	
Nb_{days}	Number of operating days per year	365	365	FSTC Life cycle calculators
N_p	Number of preheats per day	1	1	
E_p	Preheat energy (Btu)	32,000	27,000	
Er_i	Idle energy rate (Btu/hr)	80,000	65,000	
Eff	Cooking efficiency	30%	34%	
P	Electric power (kW)	0.00028	0.00028	Average values from technical specifications from various manufacturers
E_{food}	Energy transferred to food (Btu/lb)	374	374	From FSTC appliance test
P_{hr}	Production	47	47	Based on validation with FSTC

[6] Food Service Technology Center – Life-Cycle and Energy Cost Calculators - http://www.fishnick.com/saveenergy/tools/calculators/, visited in the fall of 2010

[7] NGTC, DSM Opportunities Associated with Gas-Fired Food Service Equipment, Final Report, Ver 2, June 22, 2010

[8] NGTC, Phase 3-jan14 2011 steamer corrected.xlsx

[9] NGTC,Characterizing the Demand-Side Management Potential of Gas-Fired Commercial Food Service Equipment. 2006

	capacity (lbs/hr)			calculator
$n\%$	Used to calculate time in idle mode on UG territory	82%	82%	% of time in idle mode based on results of NGTC telephone survey of full service restaurants, limited service restaurants and institutional establishments (schools, colleges, universities and hospitals) on UG territory
t_{daily}	Number of operating hours per day (hrs)	12	12	Based on NGTC telephone survey
t_p	Preheat time (hours)	0.333	0.333	Alto Shaam representative on UG territory
t_i	Hours per day in idle mode (hrs)	9.532	9.532	Calculated from $t_i = n\% * (t_{daily} - t_p)$
t_h	Time in heavy load mode, i.e. cooking time (hrs)	2.135	2.135	Calculated from $t_h = t_{daily} - (t_p + t_i)$
E_h	Daily heavy-load natural gas consumption (Btu)	Calculated		
E_i	Daily idle natural gas consumption (Btu)			
E_{annual}	Annual natural gas consumption (Btu/year)			

$$Savings = Nb_{days} * \left[E_{food} * \left(\frac{P_{hr_{base}} * t_{h_{base}}}{Eff_{base}} - \frac{P_{hr_{HE}} * t_{h_{HE}}}{Eff_{HE}}\right) + \left(Er_{i_{base}} * t_{i_{base}} - Er_{i_{HE}} * t_{i_{HE}}\right) + N_p * (E_{p_{base}} - E_{p_{HE}})\right]$$

Electricity	**0 kWh**
None	
Water	**0 L**

None

Other Input Assumptions

Equipment Life	**12 Years**
Savings attributed to the measures are expected to last the life expectancy of the equipment. Source of effective useful life: FSTC savings calculator as referenced in NGTC, DSM OPPORTUNITIES ASSOCIATED WITH GAS-FIRED FOOD SERVICE EQUIPMENT, Final Report Ver 2, April 20, 2010.	
Incremental Cost	**$ 1,270**
Incremental cost were calculated from list prices in Canadian dollars obtained from Ontarian distributors for 36 inch broilers. Base case and high-efficiency are Garland comparables. Installation and maintenance costs of high-efficiency and standard-efficiency equipment are considered to be identical. (Source: W.D. College representative). Hence, the installation and maintenance costs were not taken into account[10].	

[10] NGTC, "DSM Opportunities Associated with Gas-Fired Food Service Equipment", Final Report, Ver 2, June 22, 2010, pg 9

Commercial Space Heating

Air Curtains – Double Door (2 x 8’ x 6’)

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description

Air curtains in retail, office and institutional buildings are used to reduce infiltration of cold outside air through doorways. A reduction in air infiltration means a reduction in natural gas heating during heating season and a reduction in air conditioning during the summer season.

Base Equipment and Technologies Description

Retail, office and institutional buildings without air curtains.

Decision Type	Target Market(s)	End Use
Retrofit	Retail, Office and Institutional Buildings	Space Heating

Codes, Standards, and Regulations

N/A

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	1,529	1,023	0	2,500	0
2	1,529	1,023	0	0	0
3	1,529	1,023	0	0	0
4	1,529	1,023	0	0	0
5	1,529	1,023	0	0	0
6	1,529	1,023	0	0	0
7	1,529	1,023	0	0	0
8	1,529	1,023	0	0	0
9	1,529	1,023	0	0	0
10	1,529	1,023	0	0	0
11	1,529	1,023	0	0	0
12	1,529	1,023	0	0	0
13	1,529	1,023	0	0	0
14	1,529	1,023	0	0	0
15	1,529	1,023	0	0	0
TOTALS	**22,935**	**15,345**	**0**	**2,500**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings — 1,529 m^3

Natural gas savings reflect reduced heating load; less outside cold air passes through. Savings are estimated based on the following assumptions:

Variable Names	Symbol	Value	Source
Inside Temperature for heating season	T_{IH}	68 °F	NCI estimate
Inside Temperature for cooling season	T_{IC}	72 °F	NCI estimate
Average outside temperature in heating season	T_{OH}	29.27 °F	NCI estimate
Average outside temperature in cooling season	T_{OC}	77.00 °F	NCI estimate
Hours per day that door is open	HR	1 hour	NCI estimate
Days per week that door is in use	DPW	7 Days	NCI estimate
Door Height	H	8 '	NCI estimate
Door Width	W	2 x 6 '	NCI estimate
Total horsepower of air curtain	HP	0.5 hp	NCI estimate
Air curtain cfm at nozzle	Q_0	1005 cfm	NCI estimate
Air curtain nozzle depth	NZ	2.75 "	NCI estimate
Door coefficient	DC	0.3	NCI estimate
Days per heating season	DPS_H	120 Days	NCI estimate
Days per cooling season	DPS_C	100 Days	NCI estimate
Average wind velocity for heating season	V_{WH}	2.6 mph[1]	NCI estimate
Average wind velocity for cooling season	V_{WC}	2.1 mph	NCI estimate
Energy Efficiency Ratio for A/C Unit	EER	12 Btu/Watt-hour	NCI estimate

During Heating Season

Doorway Calculations Without Air Curtain for Heating Season:

- Air entering doorway due to wind[2], $Q_W = V_{WH} \times H \times W \times DC \times 88$ fpm/mph = 6,589 cfm
- Air entering doorway due to inside/outside temperature difference, $QTD = [68.094+0.4256(T_{IH} - T_{0H})] \times H \times W \times \sqrt{H(T_{IH} - T_{0H})} / (T_{IH} + 460)$ = 6,220 cfm
- Total air entering doorway, $Q_T = Q_W + Q_{TD}$ = 12,809 cfm
- Heat lost at doorway without air curtain $\mathbf{q_D} = 1.1 \times Q_T \times (T_{IH} - T_{0H})$ = 545,713 Btu/hr

Doorway Calculations With Air Curtain for Heating Season:

- Total air flow rate at the door, $Q_E = 0.4704\ Q_0\ (\sqrt{H/NZ}) - Q_0$ = 1,788 cfm
- Heat lost at doorway using air curtain, $\mathbf{q_{AC}} = 1.1 \times Q_E \times (T_{IH} - T_{0H})$ = 76,183 Btu/hr

Heat Loss Prevented Per Year Using Air Curtain for Heating Season:

- **$q_S = (q_D - q_{AC}) \times HR \times DPS_H \times (DPW/7)$ = 56.34 MMBtu = 1,592 m^3 natural gas.**

- Baseline estimates of natural gas consumption: heat lost at doorway without air curtains = $q_D \times HR \times DPS_H \times (DPW/7)$ = 65.49 MMBtu = 1,851 m^3.
- Natural Gas Savings % = 1,529m^3 / 1,851m^3 = 86%

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[1] An average daily wind speed of 17 km/h for winter season and 14 km/h for summer season for Pearson Airport was estimated based on Environment Canada monitoring data (Environment Canada, http://www.climate.weatheroffice.ec.gc.ca/climateData/hourlydata_e.html?timeframe=1&Prov=ON&StationID=5097&Year=2009&Month=3&Day=29). To adjust for the appropriate height and geographic characteristics for a regular building door in Greater Toronto Area, a 25% factor is applied to estimate a typical urban wind speed

[2] ASHRAE Handbook 2001 Fundamentals Ch.26

Annual Electricity Savings	1,023 kWh
• Electricity savings are a result of the following factors: - Reduced AC load - Increased electricity use to operate air curtain. • Based on the Enbridge 2007 DSM program Air Door projects at various small commercial sites, electricity savings were calculated using Agviro air door calculator. The average result is estimated to be 1,023 kWh.	
Annual Water Savings	**0 L**
N/A	

Other Input Assumptions

Effective Useful Life (EUL)	15 Years
This EUL was developed in conjunction with equipment manufacturers by Union Gas. It is also confirmed by SEED Program Guidelines[3].	
Base & Incremental Conservation Measure Equipment and O&M Costs	**$ 2,500**
This O&M cost was developed in conjunction with equipment manufacturers by Union Gas.	
Customer Payback Period (Natural Gas Only)[4]	**3.3 Years**
Using a 5-year average commodity cost (avoided cost)[5] of \$0.38 / m^3 and an average commercial distribution cost[6] of \$0.12 / m^3, the payback period for natural gas savings is determined to be 3.3 years, based on the following: Payback Period = Incremental cost / (natural gas savings x natural gas cost) = \$2500/ (1,529 m^3/year * \$0.5 / m^3) = 3.3 years	
Market Penetration[7]	**Medium**
Based on communication with local contractors, Navigant Consulting estimates a medium market penetration in Ontario.	

Measure Assumptions Used by Other Jurisdictions

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
Berner Energy Calculator[8]	4,946	N/A	2,500	N/A

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[3] Cost Effectiveness Analysis, SEED Program Guidelines. http://www.oregon.gov/ENERGY/CONS/SEED/docs/AppendixJ.pdf
[4] Customer payback period has been calculated using natural gas savings only. Where applicable, payback period is expected to decrease when electricity and/or water savings are included.
[5] 2009 Avoided gas cost provided by Union Gas. 5 year average avoided gas cost determined by taking average for baseload and weather sensitive avoided gas cost.
[6] Average distribution cost taken calculated from both Union Gas website (http://www.uniongas.com/residential/rates/) and Enbridge Gas websites (https://portal-plumprod.cgc.enbridge.com/portal/server.pt?open=512&objID=248&PageID=0&cached=true&mode=2&userID=2).
[7] Navigant Consulting is defining “Low” as below 5%, “Medium” as between 5-50%, and “High” as above 50%,
[8] Berner Calculator, http://www.berner.com/sales/energy.php5

Comments

Based on the same assumptions used above, for a typical application during the winter season, the annual natural gas savings are determined to be 175 MMBtu, or 4,946 m^3.

AIR CURTAINS (SHIPPING & RECEIVING DOORS)

Commercial/Industrial – New/Existing

Efficient Technology & Equipment Description
Air curtains are used to reduce infiltration of cold outside air through doorways. A reduction in air infiltration means a reduction in natural gas heating during heating season and a reduction in air conditioning during the summer season. For shipping/receiving doors with minimum size of 8' wide by 8' high, 8' wide by 10' high and 10' wide by 10' high located in warehousing, manufacturing, industrial or retail buildings with forced air space heating, including unit heaters.
Base Technology & Equipment Description
No air curtain.

Resource Savings Assumptions

Natural Gas	**8' x 8'**	**7,565**	**m^3**
	8' x 10'	**9,457**	**m^3**
	10' x 10'	**20,605**	**m^3**

<u>Estimation Based on Agviro Study for Enbridge</u>

- Based on Agviro's report[1], the energy analysis compares use of an air curtain versus a doorway without an air curtain. For the purposes of this analysis, the base case is assumed to be a doorway without any air restricting device. The following key input assumptions are used:

ETool Input	*Value*
Season of Operation	Winter, Spring, Fall
Door Location	Exterior
Motor Loading	85%
Motor Efficiency	80%
Curtain Effectiveness	70%
Outdoor Balance Point [Heating]	18C
Equipment Efficiency [Heating]	80%
Equipment Efficiency [Seasonal Reduction]	15%

- On a square footage per door basis, the natural gas savings for an 8' x 8' door $= 7{,}565\ m^3 / 64\ ft^2 = 118.2\ m^3 / ft^2$
- On a square footage per door basis, the natural gas savings for an 8' x 10' door $= 9{,}457\ m^3 / 80\ ft^2 = 118.2\ m^3 / ft^2$
- On a square footage per door basis, the natural gas savings for an 10' x 10' door $= 20{,}605\ m^3 / 100\ ft^2 = 206.1\ m^3 / ft^2$

The 8x8 and the 8x10 doors are considered back-up doors with various periods of either full or partial coverage by a van or trailer. This coverage reduces the Base Case airflow and thus the savings.

[1] Commercial/Industrial Air Curtain Program – Prescriptive Savings Analysis, Agviro Inc., Sep. 13, 2010

The 10x10 doors are drive-through doors. These doors are wide open and the Base Case has no restriction to airflow. More airflow provides more savings.

Electricity	**8' x 8'**	**-5,380**	**kWh**
	8' x 10'	**-5,220**	**kWh**
	10' x 10'	**-936**	**kWh**

- Installation and operation of air curtains results in a net increase in electricity consumption as a result of:
  - Increased electricity use to operate the air curtain.
- On a square footage per door basis, the electrical consumption for an 8' x 8' door = -5,380 kWh / 64 ft^2 = -84.1 kWh / ft^2
- On a square footage per door basis, the electrical consumption for an 8' x 10' door = -5,220 kWh / 80 ft^2 = -65.3 kWh / ft^2
- On a square footage per door basis, the electrical consumption for an 10' x 10' door = -936 kWh / 100 ft^2 = -9.36 kWh / ft^2

The smaller doors as discussed above are back-up doors with a van or trailer parked in front. The doors remain open during the entire loading period. This causes a larger electrical load since the air curtains are operating for the period the doors are open.

The 10x10 doors, being drive through doors, are only open while the vehicle is being driven through. The open period for the both the door and air curtain is much lower for these doors than the small doors.

Water	**0 L**

Other Input Assumptions

Equipment Life	**15 yrs**

- The estimated equipment life for air curtains was developed in conjunction with equipment manufacturers. It is also confirmed by SEED Program Guidelines[2].

Incremental Cost	**8' x 8'**	**$8,242**
	8' x 10'	**$8,242**
	10' x 10'	**$10,170**

- The costs are based on air curtain list prices plus installation cost. Installation cost includes both mechanical and electrical costs. The costs are an estimation based on discussions with an air curtain manufacturer and assuming electrical power is within 30' of the air curtain installation.
- On a square footage per door basis, the incremental cost for an 8' x 8' door = $8,242 / 64 ft^2 = 128.8 $ / ft^2

[2] Cost Effectiveness Analysis, SEED Program Guidelines.
http://www.oregon.gov/ENERGY/CONS/SEED/docs/AppendixJ.pdf

- On a square footage per door basis, the incremental cost for an 8' x 10' door = $8,242 / 80 ft^2 = 103.0 $ / ft^2
- On a square footage per door basis, the incremental cost for an 10' x 10' door = $10,170 / 100 ft^2 = 101.7 $ / ft^2

The 8x8 and 8x10 air curtains are physically identical. The costs are also identical.

Air Curtains – Single Door (8' x 6')

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description
Air curtains in retail, office and institutional buildings are used to reduce infiltration of cold outside air through doorways. A reduction in air infiltration means a reduction in natural gas heating during heating season and a reduction in air conditioning during the summer season.
Base Equipment and Technologies Description
Retail, office and institutional buildings without air curtains.

Decision Type	Target Market(s)	End Use
Retrofit	Retail, Office and Institutional Buildings	Space Heating

Codes, Standards, and Regulations

N/A

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	667	172	0	1,650	0
2	667	172	0	0	0
3	667	172	0	0	0
4	667	172	0	0	0
5	667	172	0	0	0
6	667	172	0	0	0
7	667	172	0	0	0
8	667	172	0	0	0
9	667	172	0	0	0
10	667	172	0	0	0
11	667	172	0	0	0
12	667	172	0	0	0
13	667	172	0	0	0
14	667	172	0	0	0
15	667	172	0	0	0
TOTALS	**10,005**	**2,580**	**0**	**1,650**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	667 m^3

Natural gas savings reflect reduced heating load; less outside cold air passes through doors. Savings are estimated based on the following assumptions:

Variable Names	Symbol	Value	Source
Inside Temperature for heating season	T_{IH}	68 °F	NCI estimate
Inside Temperature for cooling season	T_{IC}	72 °F	NCI estimate
Average outside temperature in heating season	T_{OH}	29.27 °F	NCI estimate
Average outside temperature in cooling season	T_{OC}	77.00 °F	NCI estimate
Hours per day that door is open	HR	1 hour	NCI estimate
Days per week that door is in use	DPW	7 Days	NCI estimate
Door Height	H	8 feet	NCI estimate
Door Width	W	6 feet	NCI estimate
Total horsepower of air curtain	HP	0.5 hp	NCI estimate
Air curtain cfm at nozzle	Q_0	1005 cfm	NCI estimate
Air curtain nozzle depth	NZ	2.75 inches	NCI estimate
Door coefficient	DC	0.3	NCI estimate
Days per heating season	DPS_H	120 Days	NCI estimate
Days per cooling season	DPS_C	100 Days	NCI estimate
Average wind velocity for heating season	V_{WH}	2.6 mph[1]	NCI estimate
Average wind velocity for cooling season	V_{WC}	2.1 mph	NCI estimate
Energy Efficiency Ratio for A/C Unit	EER	12 Btu/Watt-hour	NCI estimate

<u>**During Heating Season**</u>

Doorway Calculations Without Air Curtain for Heating Season:

- Air entering doorway due to wind[2], $Q_W = V_{WH}$ x H x W x DC x 88 fpm/mph = 3,295 cfm
- Air entering doorway due to inside/outside temperature difference, QTD = $[68.094+0.4256(T_i - T_{0H})]$ x H x W x $\sqrt{}H(T_i - T_{0H})/(T_i + 460)$ = 3,110 cfm
- Total air entering doorway, $Q_T = Q_W + Q_{TD}$ = 6,405 cfm
- Heat lost at doorway without air curtain $\mathbf{q_D}$ = 1.1 x Q_T x $(T_i - T_{0H})$ = 272,856 Btu/hr

Doorway Calculations With Air Curtain for Heating Season:

- Total air flow rate at the door, $Q_E = 0.4704\ Q_0\ (\sqrt{H/NZ}) - Q_0$ = 1,788 cfm
- Heat lost at doorway using air curtain, $\mathbf{q_{AC}}$ = 1.1 x Q_E x $(T_i - T_{0H})$ = 76,183 Btu/hr

Heat Loss Prevented Per Year Using Air Curtain for Heating Season:

- **$q_S = (q_D - q_{AC})$ x HR x DPS_H x (DPW/7) = 23.60 MMBtu = 667 m^3 natural gas.**

- Baseline estimates of natural gas consumption: heat lost at doorway without air curtains = q_D x HR x DPS_H x (DPW/7) = 32.74 MMBtu = 925 m^3.

[1] An average daily wind speed of 17 km/h for winter season and 14 km/h for summer season for Pearson Airport was estimated based on Environment Canada monitoring data (Environment Canada, http://www.climate.weatheroffice.ec.gc.ca/climateData/hourlydata_e.html?timeframe=1&Prov=ON&StationID=5097&Year=2009&Month=3&Day=29). To adjust for the appropriate height and geographic characteristics for a regular building door in Greater Toronto Area, a 25% factor is applied to estimate a typical urban wind speed

[2] ASHRAE Handbook 2001 Fundamentals Ch.26

- Natural Gas Savings % = 72.1%

Annual Electricity Savings	172 kWh

- Electricity savings are a result of the following factors:
  - Reduced AC load
  - Increased electricity use to operate air curtain.
- Based on the Enbridge 2007 DSM program Air Door projects for various small commercial sites, electricity savings were calculated using Agviro Air Door Calculator. Based on their reported results, the average savings is determined to be 172 kWh.

Annual Water Savings	0 L

N/A

Other Input Assumptions

Effective Useful Life (EUL)	15 Years

This EUL was developed in conjunction with equipment manufacturers by Union Gas. It is also confirmed by SEED Program Guidelines[3].

Base & Incremental Conservation Measure Equipment and O&M Costs	$ 1,650

This O&M cost was developed with conjunction with equipment manufacturers by Union Gas.

Customer Payback Period (Natural Gas Only)[4]	5 Years

Using a 5-year average commodity cost (avoided cost)[5] of $0.38 / m^3 and an average commercial distribution cost[6] of $0.12 / m^3, the payback period for natural gas savings is determined to be 5 years, based on the following:

Payback Period = Incremental cost / (natural gas savings x natural gas cost)
= $1,650/ (667 m^3/year * $0.5 / m^3)
≈ 5 years

Market Penetration[7]	Medium

Based on communication with local contractors, Navigant Consulting estimates a medium market penetration in Ontario.

Measure Assumptions Used by Other Jurisdictions

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
Berner Energy	2,092	N/A	2,000	N/A

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[3] Cost Effectiveness Analysis, SEED Program Guidelines. http://www.oregon.gov/ENERGY/CONS/SEED/docs/AppendixJ.pdf
[4] Customer payback period has been calculated using natural gas savings only. Where applicable, payback period is expected to decrease when electricity and/or water savings are included.
[5] 2009 Avoided gas cost provided by Union Gas. 5 year average avoided gas cost determined by taking average for baseload and weather sensitive avoided gas cost.
[6] Average distribution cost taken calculated from both Union Gas website (http://www.uniongas.com/residential/rates/) and Enbridge Gas websites (https://portal-plumprod.cgc.enbridge.com/portal/server.pt?open=512&objID=248&PageID=0&cached=true&mode=2&userID=2).
[7] Navigant Consulting is defining “Low” as below 5%, “Medium” as between 5-50%, and “High” as above 50%,

Calculator[8]				

Comments

This is a typical application during winter months. Based on the same assumptions stated above in the Annual Electricity Savings table, the saved annual natural gas is 74 MMBtu, which is equivalent to 2,092 m^3.

[8] Berner Calculator, http://www.berner.com/sales/energy.php5

CONDENSING BOILERS UNDER 300 MBH

Small Commercial – New/Existing

Efficient Technology & Equipment Description
Condensing boilers having annual fuel utilization efficiency (AFUE) of 90% or greater. Boiler input size is under 300,000 Btu/hr. Application is for seasonal or non-seasonal use. MBH is defined throughout this document as 1,000 Btu/hr.
Base Technology & Equipment Description
Non-condensing boiler having an AFUE of 80% for either seasonal or non-seasonal use. Boiler input size is under 300,000 Btu/hr.

Resource Savings Assumptions

Natural Gas	**<u>Seasonal</u>** **0.0108 m^3 /(Btu/hr Boiler Input)** **<u>Non-Seasonal</u>** **Boiler Input Under 100 MBH = 0.03579 m^3 /(Btu/hr Boiler Input)** **Boiler Input 100 To Under 200 MBH = 0.02196 m^3 /(Btu/hr)** **Boiler Input 200 To Under 300 MBH = 0.01643 m^3 /(Btu/hr)**

<u>Estimation Based on Agviro Study for Enbridge</u>

- Based on Agviro's report[1], the energy analysis compares use of a condensing boiler having an AFUE of 93% versus a base case non-condensing boiler having an AFUE of 80%.
- The normalized gas use for a seasonal base case boiler is determined by the relationship:

  $$Normalized\ Gas\ Use = 77.575 \times BoilerIP$$

  where:

  BoilerIP = seasonal boiler input size (MBH)
  Normalized Gas Use = normalized annual seasonal gas use (m3/yr)

- The gas savings for a non-seasonal base case boiler is determined by the relationship:

  $$NonSeasonal\ Gas\ Use = 36.282 \times BoilerIP + 9256.9$$

  where:

  BoilerIP = seasonal boiler input size (MBH)
  Non Seasonal Gas Use = annual non-seasonal gas use (m3/yr)

- The gas savings of the condensing versus the base case boiler is determined by the relationship:

  $$GasSavings = GasUse \times (1 - \frac{\%Eff_{BC}}{\%Eff_{CE}})$$

[1] Prescriptive Savings Analysis – Condensing Boilers Under 300MBH, Agviro Inc., Jan 17, 2011

where:

GasUse = seasonal or non-seasonal gas use (m3)
$\%Eff_{BC}$ = Efficiency of the Base Case boiler
[seasonal = 80%; non-seasonal=66.2%]
$\%Eff_{CE}$ = Efficiency of the Condensing boiler
[seasonal = 93%; non-seasonal=85.32%]
GasSavings = annual gas savings (m3/yr)

- On a per Btu/hr boiler input basis, the natural gas savings is:
  - seasonal boiler = 0.0108 m^3 / (Btu/hr)
  - non-seasonal boiler =
    - Boiler Input Under 100 MBH = 0.03579 m^3 /(Btu/hr Boiler Input)
    - Boiler Input 100 To Under 200 MBH = 0.02196 m^3 /(Btu/hr)
    - Boiler Input 200 To Under 300 MBH = 0.01643 m^3 /(Btu/hr)

Electricity	**0 kWh**
Water	**0 L**

Other Input Assumptions

Equipment Life	**25 yrs**

-

Incremental Cost

<u>Existing Construction</u>

Boiler Input (MBH)	**Incremental Cost ($)**
Under 100	**$2,045**
100 To Under 200	**$2,984**
200 To Under 300	**$3,797**

<u>New Construction</u>

Boiler Input (MBH)	**Incremental Cost ($)**
Under 100	**$1,475**
100 To Under 200	**$2,414**
200 To Under 300	**$3,227**

Incremental costs account for differences in venting, controls and labour.

<u>Incremental Cost – Existing Construction</u>

- Boiler Input Under 100 MBH = $2,045
- Boiler Input 100 To Under 200 MBH = $2,984
- Boiler Input 200 To Under 300 MBH = $3,797

Incremental Cost – New Construction

- Boiler Input Under 100 MBH = $1,475
- Boiler Input 100 To Under 200 MBH = $2,414
- Boiler Input 200 To Under 300 MBH = $3,227

Condensing Make-Up Air (MUA) Unit

Revision #	Description/Comment	Date Revised
		January 28, 2011

Efficient Equipment and Technologies Description

Condensing Make-up air unit (MUA) with:

a. Improved Efficiency (91%)
b. Improved Efficiency (91%) and 2 speed motor
c. Improved Efficiency (91%) and a variable frequency drive (VFD)

Base Equipment and Technologies Description

Conventional MUA unit with constant speed drive

Decision Type	Target Market(s)	End Use
New, Existing	Commercial	Space heating

Codes, Standards, and Regulations

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Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3/cfm)	Electricity (kWh/cfm)	Water (L)	($)	($)
1	0.41-2.92	0-1.48			
2	0.41-2.92	0-1.48			
3	0.41-2.92	0-1.48			
4	0.41-2.92	0-1.48			
5	0.41-2.92	0-1.48			
6	0.41-2.92	0-1.48			
7	0.41-2.92	0-1.48			
8	0.41-2.92	0-1.48			
9	0.41-2.92	0-1.48			
10	0.41-2.92	0-1.48			
11	0.41-2.92	0-1.48			
12	0.41-2.92	0-1.48			
13	0.41-2.92	0-1.48			
14	0.41-2.92	0-1.48			
15	0.41-2.92	0-1.48			
TOTALS	**6.15-43.8**	**0-22.2**	**0**	**$(0.66-1.02) per cfm +$870**	

Resource Savings Assumptions

Annual Natural Gas Savings	MR & LTC 0.84 m^3/cfm – 2.92 m^3/cfm Retail & Comm 0.41 m^3/cfm– 2.07 m^3/cfm

To estimate the gas savings for this measure, Navigant relied on the results of evaluations, completed by Agviro Inc., of 18 projects in which condensing MUA with improved efficiencies and in some cases 2 speed or variable frequency drives were installed in commercial applications[1]. 14 of these projects were multi-residential, 1 for long term care, 2 for retail and 1 for other commercial.

The analysis considered several heating input ranges based on the available Make-up air (MUA) models.

The efficiency for the base case and for condensing MUA's is provided by manufacturers[1] for the various heating input ranges as shown below:

Input Range (MBH)	Combustion Efficiency (%)	
	Base Case (@ High Fire)	Condensing
100-200	82	91
200-400	82	91
450-600	80.5	91
600-1,000	80	91
1,100-1,400	80	91

Gas savings for each of the 18 projects were estimated by Agviro by applying project-specific inputs (e.g., air-flow, indoor set-point temperature, hours of operation, etc.) to the proprietary Enbridge ETools calculator[2].

The ETools calculator estimates gas savings in the following manner:

The annual heat requirement to maintain the set-point air temperature is the sum of the annual heat requirement to maintain the set-point temperature between midnight and 8am, 8am and 4pm and 4pm and midnight:

$$q_{vent} = q_{vent\,00-08} + q_{vent\,08-16} + q_{vent\,16-24} \qquad (1)$$

Where:

q_{vent} = Annual heat requirement (Btu)
$q_{vent00-08}$ = Annual heat requirement (Btu) between midnight and 8am
$q_{vent09-16}$ = Annual heat requirement (Btu) between 8am and 4pm
$q_{vent16-24}$ = Annual heat requirement (Btu) between 4pm and midnight

Note that in the base case, when the circulating fan runs at a constant speed the above equation is equivalent to:

$$q_{vent} = q_{vent\,00-24} \qquad (2)$$

The savings for three types of condensing MUA units have been evaluated:

1. A unit with improved efficiency (91%)
2. A unit with improved efficiency (91%) and a 2 speed motor
3. A unit with improved efficiency (91%) and a VFD.

[1] Prescriptive Condensing MUA Program Prescriptive Savings Analysis, Agviro Inc., Oct. 25, 2010 (Rev. 21-Jan-11).
[2] An external review of Enbridge's program processes, data tracking, and oversight activities has indicated that the development and continual improvement of the ETools custom project screening tool is reflective of industry best practices.
The Cadmus Group, *Independent Audit of 2008 DSM Program Results*, June 2009. Report filed with the OEB in connection with Enbridge's application to clear DSM deferral accounts for 2008, EB-2009-0341.

The condensing MUAs with 2 speed motors and VFDs do not run at a constant speed. Schedules of the percent airflow for Multi-Res, LTC and Other Commercial applications are included in Appendix A of this document.

The annual heating requirement, q_{vent}, is calculated as shown below:

$$q_{vent} = \sum_{-5}^{T_i} 1.08QH(T_i - T_o) \qquad (3)$$

Where:

- q_{vent} = Annual heat requirement (Btu)
- Q = Ventilation rate (cfm)
- 1.08 = Energy required to raise the temperature of 1 ft^3 of air 1°F (Btu/°F/hour)
- T_i = Desired supply air temperature (°F)
- T_o = Outside temperature (°F)
- H = Total number of hours in a year which occur inside a specific 5° temperature range (as determined by average of 30 years)

The summation indicates that the equation above is calculated for a number of different outdoor temperature buckets each of five degrees C (e.g., -5 to 0, 0 to 5, etc.)

T_o and H vary with each term of the summation, where T_o is the mid-point of the given temperature bucket (e.g., for -5 to 0, T_o would be -2.5) and where H is the average number of hours in the year in which the temperature falls in the given bucket.

Gas savings are driven by the change in the annual heating requirement and the change in efficiency of the condensing MUA. The annual heating requirement for a condensing MUA with a VFD or with a 2 Speed motor can be calculated as follows:

$$q_{vent,VFD/2Speed} = (\%AirFlow_{VFD/2speed}) \times q_{vent} \qquad (4)$$

Where:

$\%AirFlow_{VFD/2speed}$ = The average airflow following the installation of the VFD or 2 speed motor expressed as a percentage of the airflow when the base technology was in place found in Appendix A.

It should be noted that when a conventional MUA is replaced with a condensing MUA that has neither a 2 speed or VFD-controlled motor, there will not be a change in airflow. In this case equation 4 will not be required in order to estimate the annual heat requirements.

Gas savings for the condensing MUA are then determined using the following equation:

$$NG_E = \left(\frac{q_{vent}}{NG_{cal}(Eff_{Base}/100)} - \frac{q_{vent,VFD/2speed}}{NG_{cal}(Eff_{VFD/2speed}/100)} \right) \times \%FA \qquad (5)$$

Where:

- NG_E = Annual gas consumption (m^3)
- q_{vent} = Annual heat requirement of the ventilation system (Btu)
- NG_{cal} = Calorific value of Natural Gas (35,000 Btu/m^3)
- Eff = Equipment efficiency (%)
- %FA = % of Fresh Air (for make-up air units this value will always be 100%)

Note that for the condensing MUA without a VFD or 2 speed fan, $q_{vent} = q_{vent,VFD/2speed}$, and gas savings are driven only by the increase in efficiency.

The savings obtained by Agviro[1] from the ETools calculator for the various cases are given below:

MUA Inputs		NG Savings m^3		
Airflow (cfm)	**MBH**	**Improved Efficiency**	**2 Speed Motor**	**VFD**
Multi-Residential				
1,700	150	1,249	3,124	4,791
3,300	300	2,424	6,064	9,300
6,000	525	5,238	11,855	17,740
9,000	800	8,282	18,208	27,036
14,000	1,250	12,884	28,324	42,055
Long Term Care				
1,700	150	1,269	3,167	4,868
3,300	300	2,539	6,335	9,735
6,000	525	5,229	11,810	17,704
9,000	800	8,269	18,139	26,980
14,000	1,250	12,934	28,372	42,200
Retail/Other Commercial				
1,700	150	616	2,047	3,425
3,300	300	1,197	3,974	6,649
6,000	525	2,586	7,635	12,499
9,000	800	4,089	11,663	18,958
14,000	1,250	6,361	18,143	29,491

MUA Inputs		Annual NG Savings m^3/cfm		
Airflow (cfm)	**MBH**	**Improved Efficiency**	**2 Speed Motor**	**VFD**
Multi-Residential				
1,700	150	0.73	1.84	2.82
3,300	300	0.73	1.84	2.82
6,000	525	0.87	1.98	2.96
9,000	800	0.92	2.02	3.00
14,000	1,250	0.92	2.02	3.00
Long Term Care				
1,700	150	0.75	1.86	2.86
3,300	300	0.77	1.92	2.95
6,000	525	0.87	1.97	2.95
9,000	800	0.92	2.02	3.00
14,000	1,250	0.92	2.03	3.01
MR & LTC Average				
1,700	150	0.74	1.84	2.82
3,300	300	0.74	1.84	2.83
6,000	525	0.87	1.98	2.96
9,000	800	0.92	2.02	3.00
14,000	1,250	0.92	2.02	3.00
MR & LTC Annual Gas Savings m^3/cfm		**0.84**	**1.94**	**2.92**
Retail/Other Commercial				
1,700	150	0.36	1.20	2.01
3,300	300	0.36	1.20	2.01
6,000	525	0.43	1.27	2.08
9,000	800	0.45	1.30	2.11
14,000	1,250	0.45	1.30	2.11
Retail/Commercial Annual Gas Savings m^3/cfm		**0.41**	**1.25**	**2.07**

In the case of the multi-residential and long term care sectors, the savings were averaged based on the number of cases in each sector to obtain the final gas savings in m^3/(cfm) for each type of condensing MUA. Enbridge has informed Navigant that the distribution of projects by sector is anticipated to be the same going forward as it has been in the past. Following program implementation if Enbridge finds the distribution of projects has changed in any significant way the savings should be re-calculated to reflect the actual distribution.

Annual Electricity Savings	**MR&LTC (0-1.48)kWh per cfm** **Retail & Comm (0-0.48)kWh per cfm**

The electricity savings for each of the 18 projects were estimated by Agviro[1] by applying project-specific inputs (e.g., air-flow, indoor set-point temperature, hours of operation, etc.) to the proprietary Enbridge ETools calculator.

No electricity savings are achieved by replacing a conventional MUA with a condensing MUA of improved efficiency. The annual electricity savings attained from installing a condensing MUA with a 2 speed motor or with a VFD is simply the difference between the electricity consumed by the constant speed drive and the 2 speed motor or the VFD.

The annual electricity consumed by the MUA motor is calculated in the following manner:

$$MotorkWh = \sum_{\%Flow_{Partial}}^{\%Flow_{Peak}} kW_{Peak,Partial} \times Operation_{Peak,Partial} (hrs / yr) \qquad (6)$$

Where:
The annual electricity consumed by the motor is calculated in the following manner:

Where:

$kW_{Peak,Partial}$= The electrical demand (kW) of the motor at peak or partial air-flow. This is itself a function of the motor's horse-power, percent motor loading, motor efficiency and control factor.

$Operation_{Peak,Partial}$= The number of hours per year at which the motor/VFD operates at peak or partial airflow.

The summation indicates that the equation above is calculated for peak and partial airflow. Appendix 1 includes scheduling of the Base Case, 2-Stage and VFD motors for Multi-Res, LTC and Commercial applications.

The annual energy savings may then be calculated as the difference in motor energy use between the Base Case and 2-Stage or VFD.

The electricity savings achieved by either a condensing MUA with a 2 speed motor or a condensing MUA with a VFD as reported by Agviro[1] are presented below:

MUA Inputs			Annual Electricity Savings by Condensing MUA Type (kWh)		
Airflow (cfm)	**Motor HP**	**Input (MBH)**	**Improved Efficiency**	**2 Speed Motor**	**VFD**
Multi-Residential					
1,700	1	150	-	953	2,597
3,300	2	300	-	1,906	5,195
6,000	3	525	-	2,859	7,792
9,000	5	800	-	4,765	12,987
14,000	8.5	1,250	-	8,101	22,077
Long Term Care					
1,700	1	150	-	953	2,597
3,330	2	300	-	1,906	5,195
6,000	3	525	-	2,859	7,792
9,000	5	800	-	4,765	12,987
14,000	8.5	1,250	-	8,101	22,077
MR & LTC Average					
1,700	1	150	-	953	2,597
3,330	2	300	-	1,906	5,195
6,000	3	525	-	2,859	7,792
9,000	5	800	-	4,765	12,987
14,000	8.5	1,250	-	8,101	22,077
MR & LTC Annual Electricity Savings kWh/cfm			**-**	**0.54**	**1.48**
Retail/Other Commercial					
1,700	1	150	-	522	846
3,300	2	300	-	1,045	1,693
6,000	3	525	-	1,567	2,539
9,000	5	800	-	2,612	4,232
14,000	8.5	1,250	-	4,441	7,195
Retail/Comm Annual Electricity Savings kWh/cfm			**-**	**0.30**	**0.48**

These savings were averaged based on the number of cases in each sector to obtain the final electricity savings in kWh for each type of condensing MUA. Enbridge has informed Navigant that the distribution of projects by sector is anticipated to be the same going forward as it has been in the past. Following program implementation if Enbridge finds the distribution of projects has changed in any significant way the savings should be re-calculated to reflect the actual distribution.

Annual Water Savings	0 L
N/A	

Other Input Assumptions

Effective Useful Life (EUL)	15 Years

Measure life estimates for condensing MUAs are not currently available. It is expected that these units may last longer than conventional MUAs, but until robust estimates of condensing MUA EULs are available, the EUL of a conventional MUA will be used. The Iowa Utility association[3] and Puget Sound Energy[4] estimated the EUL for a conventional gas MUA to be 15 years.

Incremental Costs	$870 + ($0.66 to $1.02) per cfm

The total incremental costs versus the base case for the different units are included in the table below as given in the Agviro Inc. report[1]. The condensing MUA requires a neutralizer tank to adjust the pH of the condensate before going to the drain. The condensate must then have access to a drain. Drainage can be accomplished by a number of methods including plumbing to a roof drain or plumbing through the roof and into an interior drain. Costs for the neutralizer and plumbing to drain the condensate have also been included.

cfm	Incremental Costs vs. Base Case				
	Neutralizer	Drain	Improved Efficiency	Improved Efficiency & 2 Speed Motor	Improved Efficiency & VFD
1,700	$ 120	$ 750	$ 2,007	$ 3,060	$ 3,102
3,300	$ 120	$ 750	$ 2,250	$ 3,734	$ 3,793
6,000	$ 120	$ 750	$ 3,167	$ 4,615	$ 4,673
9,000	$ 120	$ 750	$ 4,196	$ 6,325	$ 6,410
14,000	$ 120	$ 750	$ 6,418	$ 8,764	$ 8,858
Average $/cfm			**$ 0.66**	**$ 1.01**	**$ 1.02**
Incremental Cost			**$870 + $0.66*cfm**	**$870 + $1.01*cfm**	**$870 + $1.02*cfm**

[3] Summit Blue Consulting et al, Prepared for the Iowa Utility Association, *Assessment of Energy and Capacity Savings Potential in Iowa*, February, 2008.
[4] Quantec, Prepared for Pudget Sound Energy, *Comprehensive Asssessment of Demand Side Resource Potentials,* May, 2007.

Appendix A:

(Taken from the Prescriptive Condensing MUA Program Prescriptive Savings Analysis, Agviro Inc., Oct.25, 2010(Rev. 21-Jan-11)

Base Case, 2 Speed, VFD

These inputs calculate the energy and electrical savings comparing the base case unit having a single speed motor to a condensing MUA having a 2-speed motor for multi-residential, long term care, and retail/other commercial facility types. Tables of the inputs are included in Appendix B & C of the Agviro report. A schedule of hourly percent of airflow for Multi-Res and LTC are shown in Table 6.

Table 7 shows the modelled airflow schedules for Retail and Other Commercial applications. This type of facility is considered to require MUA for 12 hrs/day, 6 days/week at 72F. The Base Case unit provides 100% airflow during this period. The 2-Speed Condensing unit is considered to operate on high-speed for half the time and low-speed for the remaining; resulting in an average of 75% of the airflow over the entire operational period versus the base case. The VFD calculation assumes 50% airflow versus the Base Case.

Table 6: Schedule of Multi-Res & LTC Applications

	Multi-Res & LTC		
Hr of Day	**Base Case**	**2 Stage**	**VFD***
0	100	50	50
1	100	50	50
2	100	50	50
3	100	50	50
4	100	50	50
5	100	50	50
6	100	100	100
7	100	100	100
8	100	100	70
9	100	100	70
10	100	100	70
11	100	100	100
12	100	100	100
13	100	100	70
14	100	100	70
15	100	100	70
16	100	100	100
17	100	100	100
18	100	100	100
19	100	100	100
20	100	50	50
21	100	50	50
22	100	50	50
23	100	50	50
Weighted Ave (%):	**100.0**	**79.2**	**71.7**

Table 7: Schedule of Commercial Applications

	Commercial		
Hr of Day	Base Case	2 Stage	VFD
0	0	0	0
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	0	0	0
8	100	75	50
9	100	75	50
10	100	75	50
11	100	75	50
12	100	75	50
13	100	75	50
14	100	75	50
15	100	75	50
16	100	75	50
17	100	75	50
18	100	75	50
19	100	75	50
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
Weighted Ave (%):	50.0.	37.5	25.0

CONDENSING UNIT HEATERS

Commercial – New/Existing

Efficient Technology & Equipment Description
Condensing Unit Heaters
Base Technology & Equipment Description
% Sales Weighted Average model, equivalent in efficiency to a power-vented or separated combustion unit heater (78% Annually Efficient)[1]. For the Existing Building case, since it's not cost-effective to replace their existing unit heater prematurely, this measure is only applicable in cases of replacing their existing equipment when it's getting too old (i.e., in cases of "natural" replacement).

Resource Savings Assumptions

Natural Gas	**0.00631 m3/(BTU/H)**

Gas savings is based on the NGTC report, but modified to use a % Annual Sales Weighted base case scenario.[2] NGTC used the BIN Method combined with ASHRAE weather data[3] to estimate the annual operating hours of two Ontario regions: South (London) and North (North Bay). An oversizing factor of 100% was applied according to design practices.[4],[5] Operating hours were based on an average of the UG Northern & Southern climates (see table below).

Annual Operating Hours (BIN Method)

Region	Design Temp.	Indoor Temp.	Operating Hours
UG South (London)	-18.8 (°C)	18.3 (°C)	1,347 (hr/year)
UG North (North Bay)	-27.9 (°C)	18.3 (°C)	1,392 (hr/year)
Average	N/A	18.3 (°C)	1,370 (hr/year)

It should be noted that NRCan indicates that a unit heater's typical duty is 2,122 hrs/yr[6]. This number is significantly higher than the one obtained using the recognized ASHRAE standard. The difference could be explained by the fact that numbers obtained by NGTC using the BIN method account for the industry practice, which is to oversize unit heaters by 100%. Since no detailed information exists about how NRCan calculated typical operating hours, and given that the BIN method is an industry-recognized standard, an average operating time of 1,370 hours per year will be used for the energy consumption

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[1] based on NGTC, "DSM Opportunities Associated with Unit Heaters", April 22, 2009, pg 6 and TRC Test Bed - Feb 25 2010 426pm.xlsx

[2] based on NGTC, "DSM Opportunities Associated with Unit Heaters", April 22, 2009, pg 6 and TRC Test Bed - Feb 25 2010 426pm.xlsx

[3] ASHRAE. Weather Data Viewer: London and North Bay (Ontario). Version 3.0. 2005.

[4] Davis Energy Group. Analysis of Standards Options for Unit Heaters and Duct Furnaces. May 2004, 8 pages.

[5] NGTC. NGTC Review (no. 123807-02) - Unit Heaters Savings (retainer task for Union Gas). August 17, 2007, 9 pages.

[6] NRCan. Canada's Energy Efficiency Regulations: Gas-Fired Unit Heaters – April 2007. [On line]. October 2008. http://oee.nrcan.gc.ca/regulations/bulletin/gas-unit-heatersaprilr007. cfm?text=N&printview=N.

calculations.

The annual savings was normalized using input capacity (BTU/H)

Electricity	**(-)0.00186 kWh/(BTU/H)**

Electrical consumption will increase with the installation of condensing unit heaters. The electrical savings is based the NGTC report results modified to use a % Annual Sales Weighted base case scenario.[7] Electrical consumption values were based on manufacturer's specifications which were aggregated and summarized below.

Electricity Consumption for Unit Heater[8]

Technology	125 – 200 kBtu/hr	225 – 300 kBtu/hr
Gravity-vented	275 kWh	280 kWh
Power-vented	392 kWh	747 kWh
Separated-combustion	392 kWh	747 kWh
Condensing	657 kWh	1,020 kWh

The annual savings was normalized using input capacity (BTU/H)

Water	**NA**

Other Input Assumptions

Equipment Life	**18 yrs**

Equipment life is based on NGTC, "DSM Opportunities Associated with Unit Heaters", April 22, 2009, pg 7

Lifetime (years)	Source
20-25	Gas Research Institute (GRI, 1998, US)
10-15	University of Wisconsin – greenhouse application, 2006
19 (North of US)	ACEEE (GRI source, 1997, US)
25 (South of US)	ACEEE (GRI source, 1997, US)
15	Davis Energy Group, 2004 (prepared for California)
21.5	DOE (average data from GRI, 1997, US)
18	NRCan, 2007
18	Ecotope, Inc., 2003, prepared for Oregon
18	NGTC's estimate

NGTC estimated 18 years for the average lifetime of unit heaters.

Incremental Cost	**0.0129 $/(BTU/H)**

Incremental costs were based equipment costs and installation costs found from Canadian manufacturers as well as a US website prices converted to Canadian currency.[9] The NGTC reported incremental costs were modified to use a % Sales Weighted average base case installed cost.

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[7] based on NGTC, "DSM Opportunities Associated with Unit Heaters", April 22, 2009, pg 6 and TRC Test Bed - Feb 25 2010 426pm.xlsx
[8] based on NGTC, "DSM Opportunities Associated with Unit Heaters", April 22, 2009, pg 5
[9] based on NGTC, "DSM Opportunities Associated with Unit Heaters", April 22, 2009, pg 7-8 and TRC Test Bed - Feb 25 2010 426pm.xlsx

The incremental installed cost was normalized by input capacity (BTU/H)	
Free Ridership	**0 %**
Free Ridership was estimated using % annual sales for Condensing Unit Heaters (~0.01-0.02%) in UG territory.[10]	

[41] based on NGTC, "DSM Opportunities Associated with Unit Heaters", April 22, 2009, pg 6 and TRC Test Bed - Feb 25 2010 426pm.xlsx
[42] based on NGTC, "DSM Opportunities Associated with Unit Heaters", April 22, 2009, pg 6 and TRC Test Bed - Feb 25 2010 426pm.xlsx
[43] ASHRAE. Weather Data Viewer: London and North Bay (Ontario). Version 3.0. 2005.
[44] Davis Energy Group. Analysis of Standards Options for Unit Heaters and Duct Furnaces. May 2004, 8 pages.
[45] NGTC. NGTC Review (no. 123807-02) - Unit Heaters Savings (retainer task for Union Gas). August 17, 2007, 9 pages.
[46] NRCan. Canada's Energy Efficiency Regulations: Gas-Fired Unit Heaters – April 2007. [On line]. October 2008. http://oee.nrcan.gc.ca/regulations/bulletin/gas-unit-heatersaprilr007. cfm?text=N&printview=N.
[47] based on NGTC, "DSM Opportunities Associated with Unit Heaters", April 22, 2009, pg 6 and TRC Test Bed - Feb 25 2010 426pm.xlsx
[48] based on NGTC, "DSM Opportunities Associated with Unit Heaters", April 22, 2009, pg 5
[49] based on NGTC, "DSM Opportunities Associated with Unit Heaters", April 22, 2009, pg 7-8 and TRC Test Bed - Feb 25 2010 426pm.xlsx
[50] NGTC, "DSM Opportunities Associated with Unit Heaters", April 22, 2009, pg iii

[10] NGTC, "DSM Opportunities Associated with Unit Heaters", April 22, 2009, pg iii

DEMAND CONTROL KITCHEN VENTILATION (DCKV)

New Building Construction

Efficient Technology & Equipment Description
Ventilation with DCKV
Base Technology & Equipment Description
Ventilation without DCKV

Resource Savings Assumptions

Natural Gas	**4,801 m3**	**5,000 CFM**
	11,486 m3	**10,000 CFM**
	18,924 m3	**15000 CFM**
As approved by EB-2008-0346, Demand Kitchen Ventilation (DCKV – 5000 CFM), Decision Type: Existing. Demand Kitchen Ventilation (DCKV – 10000 CFM), Decision Type: Existing. Demand Kitchen Ventilation (DCKV – 15000 CFM), Decision Type: Existing. Usage savings are not dependant on Decision Type.		
Electricity	**13,521 kWh**	**5,000 CFM**
	30,901 kWh	**10,000 CFM**
	49,102 kWh	**15000 CFM**
As approved by EB-2008-0346, Demand Kitchen Ventilation (DCKV – 5000 CFM), Decision Type: Existing. Demand Kitchen Ventilation (DCKV – 10000 CFM), Decision Type: Existing. Demand Kitchen Ventilation (DCKV – 15000 CFM), Decision Type: Existing. Usage savings are not dependant on Decision Type.		
Water	**n/a**	**L**

Other Input Assumptions

Equipment Life	**15**	**years**
As approved by EB-2008-0346, Demand Kitchen Ventilation (DCKV – 5000 CFM), Decision Type: Existing. Demand Kitchen Ventilation (DCKV – 10000 CFM), Decision Type: Existing. Demand Kitchen Ventilation (DCKV – 15000 CFM), Decision Type: Existing. Measure life is not dependent on Decision Type		
Incremental Cost	**$10,000**	**5,000 CFM**
	$15,000	**10,000 CFM**
	$20,000	**15000 CFM**
As approved by EB-2008-0346, Demand Kitchen Ventilation (DCKV – 5000 CFM), Decision Type: Existing. Demand Kitchen Ventilation (DCKV – 10000 CFM), Decision Type: Existing. Demand Kitchen Ventilation (DCKV – 15000 CFM), Decision Type: Existing. Incremental cost is not dependent on Decision Type		
Free Ridership	**5**	**%**
FR as per 2008-0384 and 0385		

Demand Control Kitchen Ventilation (DCKV – 5000 CFM)

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description

Kitchen ventilation with DCKV hood exhaust (5000 CFM). Demand ventilation uses temperature and/or smoke sensing to adjust ventilation rates. This saves energy comparing with the traditional 100% on/off kitchen ventilation system.

Base Equipment and Technologies Description

Kitchen ventilation without DCKV.

Decision Type	Target Market(s)	End Use
Retrofit	Existing Commercial (Restaurants)	Space Heating

Codes, Standards, and Regulations

N/A

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	4,801	13,521	0	10,000	0
2	4,801	13,521	0	0	0
3	4,801	13,521	0	0	0
4	4,801	13,521	0	0	0
5	4,801	13,521	0	0	0
6	4,801	13,521	0	0	0
7	4,801	13,521	0	0	0
8	4,801	13,521	0	0	0
9	4,801	13,521	0	0	0
10	4,801	13,521	0	0	0
11	4,801	13,521	0	0	0
12	4,801	13,521	0	0	0
13	4,801	13,521	0	0	0
14	4,801	13,521	0	0	0
15	4,801	13,521	0	0	0
TOTALS	**72,015**	**202,815**	**0**	**10,000**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings — 4,801 m^3

- The demand control kitchen ventilation savings were determined using the method described in the Melink Detailed Energy Savings Report[1].
- Assuming the DCKV system is operating 16 hours/day, 7 days/week, 52 weeks/year, at 80% heating efficiency.
- Using design weather data from the Outdoor Airload Calculator[2], baseline net heating loads for an exhaust volume of 5,000 CFM were determined for two locations: London (Union South) and North Bay (Union North): London = 624,111 KBtu; and North Bay = 803,266 KBtu.
- Heating savings for both locations (London and North Bay) were calculated by multiplying the individual baseline heating loads with (*1 – estimated average make-up air RPM factor*), which represents the percent savings when using Demand Control Kitchen Ventilation.
- Weighted average natural gas savings is calculated by assigning 70% to Union Gas South consumption and 30% to Union Gas North consumption based on the customer population of Union Gas service territories.

NG Savings	Weight	Base Case Heating Load (kBTu)	Demand Ventilation Heating Load (kBTu)	Heating Savings (m^3)
Union South (London)	70%	624,111	464,963	4,421
Union North (North Bay)	30%	803,266	598,433	5,690
Weighted Average		**677,858**	**505,004**	**4,801**

- Baseline estimates of natural gas consumption = 677,858 kBtu = 18,829 m^3
- Natural Gas Savings % = 4801 m^3 / 677858 m^3 = 26 %

Annual Electricity Savings — 13,521 kWh

- Electricity savings consists two parts: fan motor savings and cooling load savings.
- Main assumption include: Motor capacity is 5 HP at 90% efficiency level, Cooling system COP = 3.
- Total Operating Time per Year (G) = 16 hrs/day x 7 days/week x 52 weeks/year = 5,824 hours
- Baseline fan motor electricity consumption = 0.746 kW/HP x G / 0.9 = 4,827.4 kWh/HP
- DCKV fan motor electricity consumption is calculated as below:

% Rated RPM	% Run Time	Time HRS/YR	Output KW/HP	System Effic.	Input KW/HP	KWHR/ HP/YR
H	I	J=GxI	K	L	M=K/L	N=JxM
100	5	291.2	0.746	0.9	0.829	241
90	20	1164.8	0.544	0.9	0.604	704
80	25	1456	0.382	0.9	0.424	618
70	25	1456	0.256	0.9	0.284	414
60	15	873.6	0.161	0.9	0.179	156
50	10	582.4	0.093	0.9	0.103	60
40	0	0	0.048	0.9	0.053	0
30	0	0	0.020	0.9	0.022	0
20	0	0	0.015	0.9	0.017	0
10	0	0	0.010	0.90	0.011	0
O Total KWH/HP/YR (Total of Column N)						**2,194** kWh/HP

[1] Detailed Energy Savings Report, Melink Corporation, http://www.melinkcorp.com/Intellihood/Energy_Analysis.pdf
[2] This freeware is available at www.archenergy.com/ckv/oac/default.htm.

- The fan motor electricity savings = 5HP x (4,827.4 – 2,194) kWh/HP = 13,167.2 kWh.
- Cooling load savings are calculated using the same method as for heating load savings analysis. Baseline net cooling loads for London and North Bay are obtained using Outdoor Airload Calculator:
  - London = 17,801 kBtu; and
  - North Bay = 5,832 kBtu.
- Multiplying the baseline cooling loads by (*1 – estimated average make-up air RPM factor*), and then assigning 70% weight to London and 30% weight to North Bay, cooling load savings are calculated and shown below:

Cooling Electricity Consumption	Weight	Base Case Cooling (kWh)	DCKV Cooling (kWh)	Cooling Savings (kWh)
Union South (London)	70%	1,739	1,296	443
Union North (North Bay)	30%	570	424	145
Weighted Average		**1,388**	**1,034**	**354**

- Total electricity savings are calculated by combining the two components of electricity usages:

Total Electricity Savings	Weight	Cooling Savings (kWh)	Exhaust Fan Motor Electricity Savings (kWh)	Total Savings (kWh)
Union South (London)	70%	443	13,167	13,611
Union North (North Bay)	30%	145	13,167	13,313
Weighted Average		**354**	**13,167**	**13,521**

- Baseline estimates of electricity consumption = 5HP x 4,827.4 kWh/HP + 1,388 kWh = 25,526 kWh.
- Electricity Savings % = 13,521 kWh / 25,526 kWh = 53 %

Annual Water Savings	**0 L**

N/A

Other Input Assumptions

Effective Useful Life (EUL)	**15 Years**

Melink Canada representative George McGrath estimates their system life at 15 years [3].

Base & Incremental Conservation Measure Equipment and O&M Costs	**$ 10,000**

Typical costing information was obtained from Melink Canada[4].

Customer Payback Period (Natural Gas Only)[5]	**4.2 Years**

Using a 5-year average commodity cost (avoided cost)[6] of \$0.38 / m^3 and an average commercial distribution cost[7] of \$0.12 / m^3, the payback period for natural gas savings is determined to be 4.2 years, based on the following:

Payback Period = Incremental cost / (natural gas savings x natural gas cost)
= \$10,000/ (4,801 m^3/year * \$0.5 / m^3)

[3] Melink Canada, February, 2009
[4] Melink Canada, http://melinkcanada.com/
[5] Customer payback period has been calculated using natural gas savings only. Where applicable, payback period is expected to decrease when electricity and/or water savings are included.
[6] 2009 Avoided gas cost provided by Union Gas. 5 year average avoided gas cost determined by taking average for baseload and weather sensitive avoided gas cost.
[7] Average distribution cost taken calculated from both Union Gas website (http://www.uniongas.com/residential/rates/) and Enbridge Gas websites (https://portal-plumprod.cgc.enbridge.com/portal/server.pt?open=512&objID=248&PageID=0&cached=true&mode=2&userID=2).

= 4.2 years	
Market Penetration[8]	**Low**
Based on the penetration rates in another jurisdiction (5% for Puget Sound Energy) and communication with local contractors, Navigant Consulting estimates a low market penetration in Ontario.	

Measure Assumptions Used by Other Jurisdictions

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
Puget Sound Energy[9]	0.0385 per ft^2	15	0.28	5%
Comments Baseline therm reported on a square footage basis (eg 0.14 therms/sq.ft. for restaurant). Estimated 10% savings for new energy efficient technology is reported as a percent saving over the baseline. Incremental costs are also based on per sqft basis. Equivalent natural gas savings is 10% x 0.14 therms/sq.ft. = 0.014 therms/sq.ft. = 0.0385 m^3 / sq.ft.				

[8] Navigant Consulting is defining “Low” as below 5%, “Medium” as between 5-50%, and “High” as above 50%,
[9] Quantec, Comprehensive Demand-Side Management Resource Assessment, Prepared for Puget Sound Energy, May 2007

33. Demand Control Kitchen Ventilation (DCKV – 10000 CFM)

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description

Kitchen ventilation with DCKV hood exhaust (10000 CFM). Demand ventilation uses temperature and/or smoke sensing to adjust ventilation rates. This saves energy comparing with the traditional 100% on/off kitchen ventilation system.

Base Equipment and Technologies Description

Kitchen ventilation without DCKV.

Decision Type	Target Market(s)	End Use
Retrofit	Existing Commercial (Restaurants)	Space Heating

Codes, Standards, and Regulations

N/A

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	11,486	30,901	0	15,000	0
2	11,486	30,901	0	0	0
3	11,486	30,901	0	0	0
4	11,486	30,901	0	0	0
5	11,486	30,901	0	0	0
6	11,486	30,901	0	0	0
7	11,486	30,901	0	0	0
8	11,486	30,901	0	0	0
9	11,486	30,901	0	0	0
10	11,486	30,901	0	0	0
11	11,486	30,901	0	0	0
12	11,486	30,901	0	0	0
13	11,486	30,901	0	0	0
14	11,486	30,901	0	0	0
15	11,486	30,901	0	0	0
TOTALS	**172,290**	**463,515**	**0**	**15,000**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings — 11,486 m^3

- The demand control kitchen ventilation savings were determined using the methodology described in the Melink Detailed Energy Savings Report[1].
- Assuming the DCKV system is operating 16 hours/day, 7 days/week, 52 weeks/year, at 80% heating efficiency.
- Using design weather data from the Outdoor Airload Calculator[2], baseline net heating loads for a exhaust volume of 10,000 CFM were determined for London (Union South) and North Bay (Union North). London:1,248,221 KBtu, North Bay: 1,660,531 KBtu
- Heating savings for London and North Bay are calculated by multiplying the individual baseline heating loads with (*1 – estimated average make-up air RPM factor*), which represents the savings% when using Demand Control Kitchen Ventilation.
- Weighted average natural gas savings is calculated by assigning 70% to Union Gas South consumption and 30% to Union Gas North consumption based on the customer population of Union Gas service territories.

NG Savings	Weight	Base Case Heating Load (kBTu)	Demand Ventilation Heating Load (kBTu)	Heating Savings (m^3)
Union South (London)	70%	1,248,221	867,514	10,575
Union North (North Bay)	30%	1,606,531	1,116,539	13,611
Weighted Average		**1,355,714**	**942,221**	**11,486**

- Baseline estimates of natural gas consumption = 1,355,714 kBtu = 37,659 m^3
- Natural Gas Savings % = 11,486 m^3 / 37, 659 m^3 = 31 %

Annual Electricity Savings — 30,901 kWh

- Electricity savings consists two parts: fan motor savings and cooling load savings.
- Assuming the motor capacity is 10 HP at 90% efficiency level, cooling system COP = 3.
- Total Operating Time per Year (G) = 16 hrs/day x 7 days/week x 52 weeks/year = 5,824 hours
- Baseline fan motor electricity consumption = 0.746 kW/HP x G / 0.9 = 4,827.4 kWh/HP
- DCKV fan motor electricity consumption is calculated as below:

% Rated RPM	% Run Time	Time HRS/YR	Output KW/HP	System Effic.	Input KW/HP	KWHR/ HP/YR
H	I	J=GxI	K	L	M=K/L	N=JxM
100	5	291.2	0.746	0.9	0.829	241
90	10	582.4	0.544	0.9	0.604	352
80	20	1164.8	0.382	0.9	0.424	494
70	20	1164.8	0.256	0.9	0.284	331
60	30	1747.2	0.161	0.9	0.179	313
50	15	873.6	0.093	0.9	0.103	90
40	0	0	0.048	0.9	0.053	0
30	0	0	0.020	0.9	0.022	0
20	0	0	0.015	0.9	0.017	0
10	0	0	0.010	0.90	0.011	0
O Total KWH/HP/YR (Total of Column N)						**1,822** kWh/HP

[1] Detailed Energy Savings Report, Melink Corporation, http://www.melinkcorp.com/Intellihood/Energy_Analysis.pdf
[2] This freeware is available at www.archenergy.com/ckv/oac/default.htm.

- The fan motor electricity savings = 10HP x (4,827.4 – 1,822) kWh/HP = 30,054 kWh.
- Cooling load savings are calculated using the same method as for heating load savings analysis. Baseline net cooling loads for London and North Bay are obtained using Outdoor Airload Calculator:
  - London = 35,603 kBtu
  - North Bay = 11,663 kBtu.
- Multiplying the baseline cooling loads by (*1 – estimated average make-up air RPM factor*), and then assigning 70% weight to London and 30% weight to North Bay, cooling load savings are calculated.

Cooling Electricity Consumption	Weight	Base Case Cooling (kWh)	DCKV Cooling (kWh)	Cooling Savings (kWh)
Union South (London)	70%	3,478	2,417	1,061
Union North (North Bay)	30%	1,139	792	348
Weighted Average		**2,777**	**1,930**	**847**

- Total electricity savings are calculated by combining the two components of electricity usages:

Total Electricity Savings	Weight	Cooling Savings (kWh)	Exhaust Fan Motor Electricity Savings (kWh)	Total Savings (kWh)
Union South (London)	70%	1,061	30,054	31,115
Union North (North Bay)	30%	348	30,054	30,402
Weighted Average		**847**	**30,054**	**30,901**

- Baseline estimates of electricity consumption = 10HP x 4,817.4kWh/HP + 2,777 kWh = 51,051 kWh.
- Electricity Savings % = 30,901 kWh / 51,051 kWh = 61 %

Annual Water Savings	**0 L**

N/A

Other Input Assumptions

Effective Useful Life (EUL)	**15 Years**

Melink Canada representative George McGrath estimates their system life at 15 years [3].

Base & Incremental Conservation Measure Equipment and O&M Costs	**$ 15,000**

Typical costing information was provided by Melink Canada[4].

Customer Payback Period (Natural Gas Only)[5]	**2.6 Years**

Using a 5-year average commodity cost (avoided cost)[6] of \$0.38 / m^3 and an average commercial distribution cost[7] of \$0.12 / m^3, the payback period for natural gas savings is determined to be 2.6 years, based on the following:

[3] Melink Canada, February, 2009
[4] Melink Canada, http://melinkcanada.com/
[5] Customer payback period has been calculated using natural gas savings only. Where applicable, payback period is expected to decrease when electricity and/or water savings are included.
[6] 2009 Avoided gas cost provided by Union Gas. 5 year average avoided gas cost determined by taking average for baseload and weather sensitive avoided gas cost.
[7] Average distribution cost taken calculated from both Union Gas website (http://www.uniongas.com/residential/rates/) and Enbridge Gas websites (https://portal-plumprod.cgc.enbridge.com/portal/server.pt?open=512&objID=248&PageID=0&cached=true&mode=2&userID=2).

Payback Period = Incremental cost / (natural gas savings x natural gas cost)
= $15,000/ (11,486 m^3/year * $0.5 / m^3)
= 2.6 years

Market Penetration[8]	Low
Based on the penetration rate in another jurisdiction (5% for Puget Sound Energy) and communication with local contractors, Navigant Consulting estimates a low market penetration in Ontario.	

Measure Assumptions Used by Other Jurisdictions

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
Puget Sound Energy[9]	0.0385 / sqft	15	0.28	5%

Comments
Baseline therm reported on a square footage basis (eg 0.14 therms/sq.ft. for restaurant). Estimated 10% savings for new energy efficient technology is reported as a percent saving over the baseline. Incremental costs are based on per sqft basis. Equivalent natural gas savings is 10% x 0.14 therms/sq.ft = 0.014 therms/sq.ft = 0.0385 m^3 /sq.ft

[8] Navigant Consulting is defining “Low” as below 5%, “Medium” as between 5-50%, and “High” as above 50%,
[9] Quantec, Comprehensive Demand-Side Management Resource Assessment, Prepared for Puget Sound Energy, May 2007

34. Demand Control Kitchen Ventilation (DCKV – 15000 CFM)

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description
Kitchen ventilation with DCKV hood exhaust (15000 CFM). Demand ventilation uses temperature and/or smoke sensing to adjust ventilation rates. This saves energy comparing with the traditional 100% on/off kitchen ventilation system.
Base Equipment and Technologies Description
Kitchen ventilation without DCKV.

Decision Type	Target Market(s)	End Use
Retrofit	Existing Commercial (Restaurants)	Space Heating

Codes, Standards, and Regulations

N/A

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	18,924	49,102	0	20,000	0
2	18,924	49,102	0	0	0
3	18,924	49,102	0	0	0
4	18,924	49,102	0	0	0
5	18,924	49,102	0	0	0
6	18,924	49,102	0	0	0
7	18,924	49,102	0	0	0
8	18,924	49,102	0	0	0
9	18,924	49,102	0	0	0
10	18,924	49,102	0	0	0
11	18,924	49,102	0	0	0
12	18,924	49,102	0	0	0
13	18,924	49,102	0	0	0
14	18,924	49,102	0	0	0
15	18,924	49,102	0	0	0
TOTALS	**283,860**	**736,530**	**0**	**20,000**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	18,924 m^3

- The demand control kitchen ventilation savings were determined using the method described in the Melink Detailed Energy Savings Report[19].
- Assuming the DCKV system is operating 16 hours/day, 7 days/week, 52 weeks/year, at 80% heating efficiency.
- Using design weather data from the Outdoor Airload Calculator[20], baseline net heating loads for London (Union South) and North Bay (Union North) at 15000 CFM exhaust volume are obtained. They are 1,872,332 kBtu and 2,409,797 kBtu respectively.
- Heating savings for London and North Bay are calculated by multiplying the individual baseline heating loads with (*1 – estimated average make-up air RPM factor*), which represents the savings% when using Demand Control Kitchen Ventilation.
- Weighted average natural gas savings is calculated by assigning 70% to Union Gas South consumption and 30% to Union Gas North consumption based on the customer population of Union Gas service territories.

NG Savings	Weight	Base Case Heating Load (kBTu)	Demand Ventilation Heating Load (kBTu)	Heating Savings (m^3)
Union South (London)	70%	1,872,332	1,245,101	17,423
Union North (North Bay)	30%	2,409,797	1,602,515	22,424
Weighted Average		**2,033,572**	**1,352,325**	**18,924**

- Baseline estimates of natural gas consumption = 2,033,572 kBtu = 56,488 m^3
- Natural Gas Savings % = 18,924 m^3 / 56,488 m^3 = 34 %

Annual Electricity Savings	49,102 kWh

- Electricity savings consists two parts: fan motor savings and cooling load savings.
- Assuming the motor capacity is 15 HP at 90% efficiency level, cooling system COP = 3.
- Total Operating Time per Year (G) = 16 hrs/day x 7 days/week x 52 weeks/year = 5,824 hours
- Baseline fan motor electricity consumption = 0.746 kW/HP x G / 0.9 = 4,827.4 kWh/HP
- DCKV fan motor electricity consumption is calculated as below:

[19] Detailed Energy Savings Report, Melink Corporation, http://www.melinkcorp.com/Intellihood/Energy_Analysis.pdf
[20] This freeware is available at www.archenergy.com/ckv/oac/default.htm.

% Rated RPM	% Run Time	Time HRS/YR	Output KW/HP	System Effic.	Input KW/HP	KWHR/ HP/YR
H	I	J=GxI	K	L	M=K/L	N=JxM
100	5	291.2	0.746	0.9	0.829	241
90	5	291.2	0.544	0.9	0.604	176
80	20	1164.8	0.382	0.9	0.424	494
70	20	1164.8	0.256	0.9	0.284	331
60	30	1747.2	0.161	0.9	0.179	313
50	10	582.4	0.093	0.9	0.103	60
40	10	582.4	0.048	0.9	0.053	31
30	0	0	0.020	0.9	0.022	0
20	0	0	0.015	0.9	0.017	0
10	0	0	0.010	0.90	0.011	0
O Total KWH/HP/YR (Total of Column N)						**1,647** kWh/HP

- The fan motor electricity savings = 15HP x (4,827.4 – 1,647) kWh/HP = 47,707 kWh.
- Cooling load savings are calculated using the same method as for heating load savings analysis. Baseline net cooling loads for London and North Bay are obtained using Outdoor Airload Calculator:
  - London = 53,404 kBtu
  - North Bay = 17,495 kBtu
- Multiplying the baseline cooling loads by (*1 – estimated average make-up air RPM factor*), and then assigning 70% weight to London and 30% weight to North Bay, cooling load savings are calculated.

Cooling Electricity Consumption	Weight	Base Case Cooling (kWh)	DCKV Cooling (kWh)	Cooling Savings (kWh)
Union South (London)	70%	5,217	3,469	1,748
Union North (North Bay)	30%	1,709	1,137	573
Weighted Average		**4,165**	**2,770**	**1,395**

- Total electricity savings are calculated by combining the two components of electricity usages:

Total Electricity Savings	Weight	Cooling Savings (kWh)	Exhaust Fan Motor Electricity Savings (kWh)	Total Savings (kWh)
Union South (London)	70%	1,748	47,707	49,455
Union North (North Bay)	30%	573	47,707	48,279
Weighted Average		**1,395**	**47,707**	**49,102**

- Baseline estimates of electricity consumption = 15HP x 4,827.4kWh/HP + 4,165 kWh = 76,577 kWh.
- Electricity Savings % = 49,102 kWh / 76,577 kWh = 64 %

Annual Water Savings	**0 L**

N/A

Other Input Assumptions

Effective Useful Life (EUL)	15 Years
Melink Canada representative George McGrath estimates their system life at 15 years [21].	
Base & Incremental Conservation Measure Equipment and O&M Costs	**$ 20,000**
Typical costing information was provided by Melink Corp.	
Customer Payback Period (Natural Gas Only)[22]	**2.1 Years**
Using a 5-year average commodity cost (avoided cost)[23] of \$0.38 / m^3 and an average commercial distribution cost[24] of \$0.12 / m^3, the payback period for natural gas savings is determined to be 2.1 years, based on the following: Payback Period = Incremental cost / (natural gas savings x natural gas cost) = \$20,000/ (18,924 m^3/year * \$0.5 / m^3) = 2.1 years	
Market Penetration[25]	**Low**
Based on the penetration rate in another jurisdiction (5% for Puget Sound Energy) and communication with local contractors, Navigant Consulting estimates a low market penetration in Ontario.	

Measure Assumptions Used by Other Jurisdictions

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
Puget Sound Energy[26]	0.0385 per ft^2	15	0.28	5%

Comments

Baseline therm reported on a square footage basis (eg 0.14 therms/sq.ft. for restaurant). Estimated 10% savings for new energy efficient technology is reported as a percent saving over the baseline. Incremental costs are based on per sqft basis. Equivalent natural gas savings is 10% x 0.14 therms/sq.ft. = 0.014 therms / sqft = 0.0385 m^3 / sqft

[21] Melink Canada, February, 2009
[22] Customer payback period has been calculated using natural gas savings only. Where applicable, payback period is expected to decrease when electricity and/or water savings are included.
[23] 2009 Avoided gas cost provided by Union Gas. 5 year average avoided gas cost determined by taking average for baseload and weather sensitive avoided gas cost.
[24] Average distribution cost taken calculated from both Union Gas website (http://www.uniongas.com/residential/rates/) and Enbridge Gas websites (https://portal-plumprod.cgc.enbridge.com/portal/server.pt?open=512&objID=248&PageID=0&cached=true&mode=2&userID=2).
[25] Navigant Consulting is defining “Low” as below 5%, “Medium” as between 5-50%, and “High” as above 50%,
[26] Quantec, Comprehensive Demand-Side Management Resource Assessment, Prepared for Puget Sound Energy, May 2007

Demand Control Kitchen Ventilation (DCKV – 10000 CFM)

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description
Kitchen ventilation with DCKV hood exhaust (10000 CFM). Demand ventilation uses temperature and/or smoke sensing to adjust ventilation rates. This saves energy comparing with the traditional 100% on/off kitchen ventilation system.
Base Equipment and Technologies Description
Kitchen ventilation without DCKV.

Decision Type	Target Market(s)	End Use
Retrofit	Existing Commercial (Restaurants)	Space Heating

Codes, Standards, and Regulations

N/A

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	11,486	30,901	0	15,000	0
2	11,486	30,901	0	0	0
3	11,486	30,901	0	0	0
4	11,486	30,901	0	0	0
5	11,486	30,901	0	0	0
6	11,486	30,901	0	0	0
7	11,486	30,901	0	0	0
8	11,486	30,901	0	0	0
9	11,486	30,901	0	0	0
10	11,486	30,901	0	0	0
11	11,486	30,901	0	0	0
12	11,486	30,901	0	0	0
13	11,486	30,901	0	0	0
14	11,486	30,901	0	0	0
15	11,486	30,901	0	0	0
TOTALS	**172,290**	**463,515**	**0**	**15,000**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	11,486 m^3

- The demand control kitchen ventilation savings were determined using the methodology described in the Melink Detailed Energy Savings Report[1].
- Assuming the DCKV system is operating 16 hours/day, 7 days/week, 52 weeks/year, at 80% heating efficiency.
- Using design weather data from the Outdoor Airload Calculator[2], baseline net heating loads for a exhaust volume of 10,000 CFM were determined for London (Union South) and North Bay (Union North). London:1,248,221 KBtu, North Bay: 1,660,531 KBtu
- Heating savings for London and North Bay are calculated by multiplying the individual baseline heating loads with (*1 – estimated average make-up air RPM factor*), which represents the savings% when using Demand Control Kitchen Ventilation.
- Weighted average natural gas savings is calculated by assigning 70% to Union Gas South consumption and 30% to Union Gas North consumption based on the customer population of Union Gas service territories.

NG Savings	Weight	Base Case Heating Load (kBTu)	Demand Ventilation Heating Load (kBTu)	Heating Savings (m^3)
Union South (London)	70%	1,248,221	867,514	10,575
Union North (North Bay)	30%	1,606,531	1,116,539	13,611
Weighted Average		**1,355,714**	**942,221**	**11,486**

- Baseline estimates of natural gas consumption = 1,355,714 kBtu = 37,659 m^3
- Natural Gas Savings % = 11,486 m^3 / 37, 659 m^3 = 31 %

Annual Electricity Savings	30,901 kWh

- Electricity savings consists two parts: fan motor savings and cooling load savings.
- Assuming the motor capacity is 10 HP at 90% efficiency level, cooling system COP = 3.
- Total Operating Time per Year (G) = 16 hrs/day x 7 days/week x 52 weeks/year = 5,824 hours
- Baseline fan motor electricity consumption = 0.746 kW/HP x G / 0.9 = 4,827.4 kWh/HP
- DCKV fan motor electricity consumption is calculated as below:

[1] Detailed Energy Savings Report, Melink Corporation, http://www.melinkcorp.com/Intellihood/Energy_Analysis.pdf
[2] This freeware is available at www.archenergy.com/ckv/oac/default.htm.

% Rated RPM	% Run Time	Time HRS/YR	Output KW/HP	System Effic.	Input KW/HP	KWHR/ HP/YR
H	I	J=GxI	K	L	M=K/L	N=JxM
100	5	291.2	0.746	0.9	0.829	241
90	10	582.4	0.544	0.9	0.604	352
80	20	1164.8	0.382	0.9	0.424	494
70	20	1164.8	0.256	0.9	0.284	331
60	30	1747.2	0.161	0.9	0.179	313
50	15	873.6	0.093	0.9	0.103	90
40	0	0	0.048	0.9	0.053	0
30	0	0	0.020	0.9	0.022	0
20	0	0	0.015	0.9	0.017	0
10	0	0	0.010	0.90	0.011	0
O Total KWH/HP/YR (Total of Column N)						**1,822** kWh/HP

- The fan motor electricity savings = 10HP x (4,827.4 – 1,822) kWh/HP = 30,054 kWh.
- Cooling load savings are calculated using the same method as for heating load savings analysis. Baseline net cooling loads for London and North Bay are obtained using Outdoor Airload Calculator:
  - London = 35,603 kBtu
  - North Bay = 11,663 kBtu.
- Multiplying the baseline cooling loads by (*1 – estimated average make-up air RPM factor*), and then assigning 70% weight to London and 30% weight to North Bay, cooling load savings are calculated.

Cooling Electricity Consumption	Weight	Base Case Cooling (kWh)	DCKV Cooling (kWh)	Cooling Savings (kWh)
Union South (London)	70%	3,478	2,417	1,061
Union North (North Bay)	30%	1,139	792	348
Weighted Average		**2,777**	**1,930**	**847**

- Total electricity savings are calculated by combining the two components of electricity usages:

Total Electricity Savings	Weight	Cooling Savings (kWh)	Exhaust Fan Motor Electricity Savings (kWh)	Total Savings (kWh)
Union South (London)	70%	1,061	30,054	31,115
Union North (North Bay)	30%	348	30,054	30,402
Weighted Average		**847**	**30,054**	**30,901**

- Baseline estimates of electricity consumption = 10HP x 4,817.4kWh/HP + 2,777 kWh = 51,051 kWh.
- Electricity Savings % = 30,901 kWh / 51,051 kWh = 61 %

Annual Water Savings	**0 L**

N/A

Other Input Assumptions

Effective Useful Life (EUL)	15 Years
Melink Canada representative George McGrath estimates their system life at 15 years [3].	
Base & Incremental Conservation Measure Equipment and O&M Costs	**$ 15,000**
Typical costing information was provided by Melink Canada[4].	
Customer Payback Period (Natural Gas Only)[5]	**2.6 Years**
Using a 5-year average commodity cost (avoided cost)[6] of \$0.38 / m^3 and an average commercial distribution cost[7] of \$0.12 / m^3, the payback period for natural gas savings is determined to be 2.6 years, based on the following: Payback Period = Incremental cost / (natural gas savings x natural gas cost) = \$15,000/ (11,486 m^3/year * \$0.5 / m^3) = 2.6 years	
Market Penetration[8]	**Low**
Based on the penetration rate in another jurisdiction (5% for Puget Sound Energy) and communication with local contractors, Navigant Consulting estimates a low market penetration in Ontario.	

Measure Assumptions Used by Other Jurisdictions

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
Puget Sound Energy[9]	0.0385 / sqft	15	0.28	5%
Comments Baseline therm reported on a square footage basis (eg 0.14 therms/sq.ft. for restaurant). Estimated 10% savings for new energy efficient technology is reported as a percent saving over the baseline. Incremental costs are based on per sqft basis. Equivalent natural gas savings is 10% x 0.14 therms/sq.ft = 0.014 therms/sq.ft = 0.0385 m^3 /sq.ft				

[3] Melink Canada, February, 2009
[4] Melink Canada, http://melinkcanada.com/
[5] Customer payback period has been calculated using natural gas savings only. Where applicable, payback period is expected to decrease when electricity and/or water savings are included.
[6] 2009 Avoided gas cost provided by Union Gas. 5 year average avoided gas cost determined by taking average for baseload and weather sensitive avoided gas cost.
[7] Average distribution cost taken calculated from both Union Gas website (http://www.uniongas.com/residential/rates/) and Enbridge Gas websites (https://portal-plumprod.cgc.enbridge.com/portal/server.pt?open=512&objID=248&PageID=0&cached=true&mode=2&userID=2).
[8] Navigant Consulting is defining "Low" as below 5%, "Medium" as between 5-50%, and "High" as above 50%,
[9] Quantec, Comprehensive Demand-Side Management Resource Assessment, Prepared for Puget Sound Energy, May 2007

Demand Control Kitchen Ventilation (DCKV – 15000 CFM)

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description
Kitchen ventilation with DCKV hood exhaust (15000 CFM). Demand ventilation uses temperature and/or smoke sensing to adjust ventilation rates. This saves energy comparing with the traditional 100% on/off kitchen ventilation system.
Base Equipment and Technologies Description
Kitchen ventilation without DCKV.

Decision Type	Target Market(s)	End Use
Retrofit	Existing Commercial (Restaurants)	Space Heating

Codes, Standards, and Regulations

N/A

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	18,924	49,102	0	20,000	0
2	18,924	49,102	0	0	0
3	18,924	49,102	0	0	0
4	18,924	49,102	0	0	0
5	18,924	49,102	0	0	0
6	18,924	49,102	0	0	0
7	18,924	49,102	0	0	0
8	18,924	49,102	0	0	0
9	18,924	49,102	0	0	0
10	18,924	49,102	0	0	0
11	18,924	49,102	0	0	0
12	18,924	49,102	0	0	0
13	18,924	49,102	0	0	0
14	18,924	49,102	0	0	0
15	18,924	49,102	0	0	0
TOTALS	**283,860**	**736,530**	**0**	**20,000**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	18,924 m^3

- The demand control kitchen ventilation savings were determined using the method described in the Melink Detailed Energy Savings Report[1].
- Assuming the DCKV system is operating 16 hours/day, 7 days/week, 52 weeks/year, at 80% heating efficiency.
- Using design weather data from the Outdoor Airload Calculator[2], baseline net heating loads for London (Union South) and North Bay (Union North) at 15000 CFM exhaust volume are obtained. They are 1,872,332 kBtu and 2,409,797 kBtu respectively.
- Heating savings for London and North Bay are calculated by multiplying the individual baseline heating loads with (*1 – estimated average make-up air RPM factor*), which represents the savings% when using Demand Control Kitchen Ventilation.
- Weighted average natural gas savings is calculated by assigning 70% to Union Gas South consumption and 30% to Union Gas North consumption based on the customer population of Union Gas service territories.

NG Savings	Weight	Base Case Heating Load (kBTu)	Demand Ventilation Heating Load (kBTu)	Heating Savings (m^3)
Union South (London)	70%	1,872,332	1,245,101	17,423
Union North (North Bay)	30%	2,409,797	1,602,515	22,424
Weighted Average		**2,033,572**	**1,352,325**	**18,924**

- Baseline estimates of natural gas consumption = 2,033,572 kBtu = 56,488 m^3
- Natural Gas Savings % = 18,924 m^3 / 56,488 m^3 = 34 %

Annual Electricity Savings	49,102 kWh

- Electricity savings consists two parts: fan motor savings and cooling load savings.
- Assuming the motor capacity is 15 HP at 90% efficiency level, cooling system COP = 3.
- Total Operating Time per Year (G) = 16 hrs/day x 7 days/week x 52 weeks/year = 5,824 hours
- Baseline fan motor electricity consumption = 0.746 kW/HP x G / 0.9 = 4,827.4 kWh/HP
- DCKV fan motor electricity consumption is calculated as below:

[1] Detailed Energy Savings Report, Melink Corporation, http://www.melinkcorp.com/Intellihood/Energy_Analysis.pdf
[2] This freeware is available at www.archenergy.com/ckv/oac/default.htm.

% Rated RPM	% Run Time	Time HRS/YR	Output KW/HP	System Effic.	Input KW/HP	KWHR/ HP/YR
H	I	J=GxI	K	L	M=K/L	N=JxM
100	5	291.2	0.746	0.9	0.829	241
90	5	291.2	0.544	0.9	0.604	176
80	20	1164.8	0.382	0.9	0.424	494
70	20	1164.8	0.256	0.9	0.284	331
60	30	1747.2	0.161	0.9	0.179	313
50	10	582.4	0.093	0.9	0.103	60
40	10	582.4	0.048	0.9	0.053	31
30	0	0	0.020	0.9	0.022	0
20	0	0	0.015	0.9	0.017	0
10	0	0	0.010	0.90	0.011	0
O Total KWH/HP/YR (Total of Column N)						**1,647** kWh/HP

- The fan motor electricity savings = 15HP x (4,827.4 – 1,647) kWh/HP = 47,707 kWh.
- Cooling load savings are calculated using the same method as for heating load savings analysis. Baseline net cooling loads for London and North Bay are obtained using Outdoor Airload Calculator:
  - London = 53,404 kBtu
  - North Bay = 17,495 kBtu
- Multiplying the baseline cooling loads by (*1 – estimated average make-up air RPM factor*), and then assigning 70% weight to London and 30% weight to North Bay, cooling load savings are calculated.

Cooling Electricity Consumption	Weight	Base Case Cooling (kWh)	DCKV Cooling (kWh)	Cooling Savings (kWh)
Union South (London)	70%	5,217	3,469	1,748
Union North (North Bay)	30%	1,709	1,137	573
Weighted Average		**4,165**	**2,770**	**1,395**

- Total electricity savings are calculated by combining the two components of electricity usages:

Total Electricity Savings	Weight	Cooling Savings (kWh)	Exhaust Fan Motor Electricity Savings (kWh)	Total Savings (kWh)
Union South (London)	70%	1,748	47,707	49,455
Union North (North Bay)	30%	573	47,707	48,279
Weighted Average		**1,395**	**47,707**	**49,102**

- Baseline estimates of electricity consumption = 15HP x 4,827.4kWh/HP + 4,165 kWh = 76,577 kWh.
- Electricity Savings % = 49,102 kWh / 76,577 kWh = 64 %

Annual Water Savings	**0 L**

N/A

Other Input Assumptions

Effective Useful Life (EUL)	15 Years
Melink Canada representative George McGrath estimates their system life at 15 years [3].	
Base & Incremental Conservation Measure Equipment and O&M Costs	**$ 20,000**
Typical costing information was provided by Melink Corp.	
Customer Payback Period (Natural Gas Only)[4]	**2.1 Years**
Using a 5-year average commodity cost (avoided cost)[5] of \$0.38 / m^3 and an average commercial distribution cost[6] of \$0.12 / m^3, the payback period for natural gas savings is determined to be 2.1 years, based on the following: Payback Period = Incremental cost / (natural gas savings x natural gas cost) = \$20,000/ (18,924 m^3/year * \$0.5 / m^3) = 2.1 years	
Market Penetration[7]	**Low**
Based on the penetration rate in another jurisdiction (5% for Puget Sound Energy) and communication with local contractors, Navigant Consulting estimates a low market penetration in Ontario.	

Measure Assumptions Used by Other Jurisdictions

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
Puget Sound Energy[8]	0.0385 per ft^2	15	0.28	5%

Comments

Baseline therm reported on a square footage basis (eg 0.14 therms/sq.ft. for restaurant). Estimated 10% savings for new energy efficient technology is reported as a percent saving over the baseline. Incremental costs are based on per sqft basis. Equivalent natural gas savings is 10% x 0.14 therms/sq.ft. = 0.014 therms / sqft = 0.0385 m^3 / sqft

[3] Melink Canada, February, 2009
[4] Customer payback period has been calculated using natural gas savings only. Where applicable, payback period is expected to decrease when electricity and/or water savings are included.
[5] 2009 Avoided gas cost provided by Union Gas. 5 year average avoided gas cost determined by taking average for baseload and weather sensitive avoided gas cost.
[6] Average distribution cost taken calculated from both Union Gas website (http://www.uniongas.com/residential/rates/) and Enbridge Gas websites (https://portal-plumprod.cgc.enbridge.com/portal/server.pt?open=512&objID=248&PageID=0&cached=true&mode=2&userID=2).
[7] Navigant Consulting is defining "Low" as below 5%, "Medium" as between 5-50%, and "High" as above 50%,
[8] Quantec, Comprehensive Demand-Side Management Resource Assessment, Prepared for Puget Sound Energy, May 2007

Destratification Fan – New or Existing Commercial

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description
Destratification Fan. For fans of with minimum diameter of 20' located in warehousing, manufacturing, industrial or retail buildings[1] with forced air space heating, including unit heaters .
Base Equipment and Technologies Description
No destratification fan.

Decision Type	Target Market(s)	End Use
New, Replacement	Commercial (New or Existing)	Space Heating

Codes, Standards, and Regulations

N/A

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3/ft^2)	Electricity (kWh/ft^2)	Water (L)	($)	($)
1	0.5	-0.0034	0	7,021	0
2	0.5	-0.0034	0	0	0
3	0.5	-0.0034	0	0	0
4	0.5	-0.0034	0	0	0
5	0.5	-0.0034	0	0	0
6	0.5	-0.0034	0	0	0
7	0.5	-0.0034	0	0	0
8	0.5	-0.0034	0	0	0
9	0.5	-0.0034	0	0	0
10	0.5	-0.0034	0	0	0
11	0.5	-0.0034	0	0	0
12	0.5	-0.0034	0	0	0
13	0.5	-0.0034	0	0	0
14	0.5	-0.0034	0	0	0
15	0.5	-0.0034	0	0	0
TOTALS	**7.5**	**-0.068**	**0**	**7,021**	**0**

[1] Buildings with a minimum of 25" ceilings.

Resource Savings Assumptions

Annual Natural Gas Savings	0.5 m^3 / ft^2

Estimation Based on Agviro Study for Enbridge

- Based on the Agviro's report[2], which was based largely on an analysis of energy savings due to destratification fans installed at the commercial manufacturing and warehousing facility of Hunter-Douglas during the winter of 2008[3], the following key assumptions are used:

Key Enbridge Input Assumptions	
Effective destratification area (ft^2)	13,270
Ceiling Height (ft)	30
Heater Height (ft)	20
Electric Motor Nameplate HP	1.5
Annual Operation Hours	5,186
Fan Diameter	24'
Thermostat Setpoint (^oF)	72
Thermostat Reduction [after detratification] (^oF)	2

- The Hunter-Douglas monitoring results provided important input assumptions for modeling purposes using Enbridge's ETool. However, certain factors in the monitoring were below industry standard. For example, the destratification fan was operated at speed of 15 Hz on site, which is slower than the typical or average fan speed at 20 Hz. When modeling the gas savings using ETool, Enbridge considered this factor, and revised fan speed up to 20 Hz. The modeled gas savings results are presented as follows:

Enbridge's ETool Modeling Results	
Electricity Consumption (kWh)	890
Auxiliary Electrical Savings (kWh)	767
Natural Gas Savings (m^3)	7,020

- However, due to Navigant Consulting's lack of access to ETool to verify the calculation process of natural gas savings, Navigant Consulting opted to use Union Gas destratification fan calculator based on Enbridge's input assumptions in the presented table.

Navigant Consulting Estimation Based on Union Gas Calculator

- Using the Destratification fan calculator provided by Union Gas and the same set of input assumptions used by Enbridge, natural gas savings are presented as follows:

Navigant Estimated Gas Savings Results	
Electricity Consumption (kWh)	812
Auxiliary Electrical Savings (kWh)	-
Natural Gas Savings (m^3)	6,828

- On a per square footage basis, the natural gas savings = 6,828 m^3 / 13,270 ft^2 = 0.51 m^3/ft^2.

Annual Electricity Savings	– 0.0034 kWh / ft^2

- The auxiliary electrical savings represents electrical savings through the reduced use of auxiliary heating equipment such as blower motors on space heating equipment[4]. Union Gas calculator does

[2] Prescriptive Destratification Fan Program – Prescriptive Savings Analysis, Agviro Inc., Feb 2, 2009
[3] Cold Weather Destratification, Hunter Douglas Monitoring Results, Final Report, May 2008
[4] Prescriptive Destratification Fan Program – Prescriptive Savings Analysis, Agviro Inc., Feb 2, 2009

not include this savings impact in its calculation process. Enbridge developed an equation to correlate electrical power to unit heater input size based on specifications for commercial space heating equipments.

- Since the key input assumptions used in Union Gas calculator are based on the inputs provided by Agviro report and the calculated electrical savings are within 10% of the reported Enbridge gas savings. Navigant Consulting assumes same amount of auxiliary electrical savings can be achieved by destratification fans in Union Gas service territories.
- Therefore, net electricity consumption (kWh) = electricity consumptions in electric motor (kWh) – auxiliary electrical saving (kWh) = 812 kWh – 767 kWh = 45 kWh
- On a per square footage basis, the electricity savings = – 45 kWh / 13,270 ft^2 = – 0.0034 kWh/ft^2.

Annual Water Savings	0 L

N/A

Other Input Assumptions

Effective Useful Life (EUL)	15 Years

The estimated equipment life for de-stratification fans is 15 years[5]. This value is also supported by ASHRAE[6], which lists the service life for propeller fans as 15 years.

Base & Incremental Conservation Measure Equipment and O&M Costs	$7,021

The weighted average costs are based on market shares described above and cost data[7].

	Fan Sizes	
Results	24' diameter	20' diameter
Incremental Cost for 1 Fan	$7,088	$6,885
Market Share	55%	27%
Weighted Average Cost	$7,021	

According to Envira-North (a local Canadian manufacturer of destratification fans), the suggested retail price for a de-stratification fan with a 2' drop from the ceiling, 2 HP and stealth blade is $6,000. For the 20' fan with 1' drop, 1 HP and a stellar blade, the price is $5,200.

Customer Payback Period (Natural Gas Only)[8]	2.1 Years

Using a 5-year average commodity cost (avoided cost)[9] of \$0.38 / m^3 and an average commercial distribution cost[10] of \$0.12 / m^3, the payback period for natural gas savings is determined to be 2.1 years, based on the following:

Payback Period = Incremental cost / (natural gas savings x natural gas cost)
= \$7,021 / (6,828 m^3/year * \$0.5 / m^3)
= 2.1 years

[5] SEED Program Guideline, J-20, December 2004, http://www.oregon.gov/ENERGY/CONS/SEED/docs/AppendixJ.pdf
[6] ASHRAE Handbook, HVAC Applications SI Edition. Chapter 36 – Table 4. Pg.36.3, 2007.
[7] Targeted Market Study. HVLS Fans on Wisconsin Dairy Farms. State of Wisconsin Department of Administration Division of Energy. June 12, 2006., RSMeans. Mechanical Cost Data – 29th Annual Edition. 2006, and communications with Manufactures.
[8] Customer payback period has been calculated using natural gas savings only. Where applicable, payback period is expected to decrease when electricity and/or water savings are included.
[9] 2009 Avoided gas cost provided by Union Gas. 5 year average avoided gas cost determined by taking average for baseload and weather sensitive avoided gas cost.
[10] Average distribution cost taken calculated from both Union Gas website (http://www.uniongas.com/residential/rates/) and Enbridge Gas websites (https://portal-plumprod.cgc.enbridge.com/portal/server.pt?open=512&objID=248&PageID=0&cached=true&mode=2&userID=2).

Market Penetration[11]	Low
Based on conversations with suppliers of destratification fans, Navigant Consulting estimates that fewer than 5% of buildings in Ontario capable of installing the technology currently have them installed. Although this is considered to be low market penetration, this technology is relatively new and the penetration is steadily growing.	

Measure Assumptions Used by Other Jurisdictions

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
N/A	N/A	N/A	N/A	N/A
Comments N/A				

[11] Navigant Consulting is defining "Low" as below 5%, "Medium" as between 5-50%, and "High" as above 50%,

Energy Recovery Ventilator (ERV) – New Commercial

Revision #	Description/Comment	Date Revised
		September 16, 2010

Efficient Equipment and Technologies Description
Ventilation with ERV
Base Equipment and Technologies Description
Ventilation without ERV

Decision Type	Target Market(s)	End Use
New	New Commercial	Space Heating

Codes, Standards, and Regulations

1) Restriction for new building construction: This measure is not applicable to system ≥5,000 CFM with ≥70% OA ratio because energy recovery is required by Ontario Building Code 2006.
2) Restriction for new building construction: This measure is not applicable to systems serving health care spaces indicated in **Table 1** because heat recovery is required by CSA Z317.2-01

Table 1 - Health Care Spaces Not Eligible		
Anaesthetic gas scavenging	Cart and can washers	Areas using hazardous gases
Animal facilities	Chemical storage	Isolation rooms
Autopsy suite	Cooking facilities	Perchloric hoods
Biohazard and fume hoods	Ethylene oxide	Radioisotope hoods

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3/CFM)	Electricity (kWh)	Water (L)	($/CFM)	($)
1	2.05 – 5.77	0	0	3.18	0
2	2.05 – 5.77	0	0	0	0
3	2.05 – 5.77	0	0	0	0
4	2.05 – 5.77	0	0	0	0
5	2.05 – 5.77	0	0	0	0
6	2.05 – 5.77	0	0	0	0
7	2.05 – 5.77	0	0	0	0
8	2.05 – 5.77	0	0	0	0
9	2.05 – 5.77	0	0	0	0
10	2.05 – 5.77	0	0	0	0
11	2.05 – 5.77	0	0	0	0
12	2.05 – 5.77	0	0	0	0
13	2.05 – 5.77	0	0	0	0
14	2.05 – 5.77	0	0	0	0
TOTALS	**28.7 – 80.8**	**0**	**0**	**3.18**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings — 2.05 – 5.77 m^3/CFM

- ERV gas savings in new buildings is determined in the same way as in the ERV gas savings in existing buildings except the balance point temperature of a building. The balance point temperature of a building is selected based on building's thermal characteristics (internal & solar heat gains, infiltration rates and indoor temperature settings). Generally, older buildings (pre-1970's) or buildings with low internal heat gains (residences, motels, supermarkets, warehouses) should consider using a base HDD65°F or HDD60°F value. New buildings built to current OBC standards or buildings with high internal heat gains (retail, restaurants, offices) should consider using base HDD55°F, HDD50°F or even lower balance point temperature.
- Natural gas savings are determined from engineering calculations utilizing inputs such as air flow, indoor/outdoor temperatures, indoor/outdoor and relative humidity.

Symbols	Variable Names	Values	Source
A	Supply air flow (cfm)	ERV Capacity	UG
B	Exhaust air flow (cfm)	ERV Capacity	UG
C	Average Indoor Air Temperature (°F)	70	UG
D	Average Indoor Relative Humidity (%)	30	UG
E	Average Outside Air Temperature (°F)	Adjust Based On District	N
F	Average Outdoor Relative Humidity (%)	75	N
G	Atmospheric Pressure (psia)	14.25	UG
H	No. Of Hours in Heating Season (hrs)	Adjust Based On District	N
I2	No. Of Hours Of Operation Per Week	See Table Below	N
K	Effectiveness Of Heat Recovery Equipment (%)	67	N
L	Sensible Heat Recovery Only	no	UG
M	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of INLET Exhaust Air	Calculated	UG
N	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of INLET Supply Air	Calculated	UG
O	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of OUTLET supply Air	Calculated	UG
P	Average Temperature of OUTLET Supply Air (°F)	Calculated	UG
Q	Average Hourly Moisture Addition (lb/hr)	Calculated	UG
R	Defrost Control Derating Factor (%)	5	UG
S	Average Hourly Heat Recovery (MBH)	Calculated	UG
T	Season Efficiency of Gas-Fired Equipment (%)	82	UG
U	Average Annual Gas Reduction (m^3)	Calculated	UG
V	Incremental Natural Gas Reduction ($/$m^3$)	0.3	UG
W	Average Annual Gas Savings ($)	Calculated	UG

UG - Union Gas

N - Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010

NG Savings = # of Hours in Heating Season x (operating hours/168) x Average Hourly Heat Recovery / (35.3 m^3/MJ) / (Seasonal Efficiency / 100%) **(A)**

- 168 hour = 7 days/week x 24hours/day

Average Hourly Heat Recovery = Supply air flow x 60 x (Supply air flow – Inlet supply air)/Specific Supply Air Conditions Volume x (1 – Defrost Control De-rating Factor[1] %) **(B)**

[1] From Union Gas, all air-to-air heat recovery equipment requires frost control in colder climates to prevent freeze-up of exhaust air condensate on heat exchange components. Depending on the defrost control system, annual heat recovery estimates should be reduced by 5 to 15 %. Equipment manufacturers and suppliers can provide an estimated defrost derating factor given the operating conditions of the equipment.

- Operating hours for each sectors being considered are as the following

Segment	Hours of Operation per Week
Multi-Family	168
Health Care	168
Nursing Home	168
Hotel	120
Restaurant	87
Retail	73
Office	64
Warehouse	61
School	54

- New buildings and existing buildings mainly differ in the enthalpy (BTU/LBa) that is used to calculate the Specific Supply Air Conditions Volume in formula **(B).**
- Based on the NG Savings formula (A) and input assumptions above, the natural gas savings for each of the commercial sectors are calculated. Gas savings for each district were combined using a 70/30 South/North split. Markets with similar gas savings were combined to reduce administration costs and to simplify the program.

			New Buildings	
Grouping	Segment	ERV Capacity (CFM)	Gas Savings (m^3)	Gas Savings per CFM (m^3/CFM)
High Use	Multi-Family Health Care Nursing Home	500	2885	5.77
Medium Use	Hotel Restaurant Retail	500	1603	3.21
Low Use	Office Warehouse School	500	1025	2.05

Annual Electricity Savings	0 kWh

N/A

Annual Water Savings	0 L

N/A

Other Input Assumptions

Effective Useful Life (EUL)	14 Years
The 14 year life recommended by DEER is based on KEMA-XENERGY's *Retention Study of PG&Es 1996-1997 Energy Incentive Program* (50). This study tracked installed equipment over 6 years and used statistical analysis to calculate EUL.[2]	
Incremental Costs	**$3.18 / CFM**
The incremental costs are based on relative scaling of incremental costs $2,500 / 1000 CFM[3]. Based on communication with local contractors, the incremental costs are $3/CFM. Nexant recommends increasing the incremental cost by inflation, to $3.18/CFM.[4]	

[2] Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010, page 6-32

[3] "Prescriptive Incentives for Selected Natural Gas Technologies", Prepared for Enbridge Consumers Gas and Union Gas Ltd., by Jacques Whitford Environment Limited, Agviro Inc., and Engineering Interface Ltd., September 27, 2000.

[4] Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010, page 6-34

Energy Recovery Ventilator (ERV) – Existing Commercial

Revision #	Description/Comment	Date Revised
		September 16, 2010

Efficient Equipment and Technologies Description
Ventilation with an Energy Recovery Ventilator (ERV)
Base Equipment and Technologies Description
Ventilation without an Energy Recovery Ventilator (ERV)

Decision Type	Target Market(s)	End Use
Replacement	Existing Commercial	Space Heating

Codes, Standards, and Regulations

N/A

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3/CFM)	Electricity (kWh)	Water (L)	($/CFM)	($)
1	2.17 – 6.12	0	0	3.18	0
2	2.17 – 6.12	0	0	0	0
3	2.17 – 6.12	0	0	0	0
4	2.17 – 6.12	0	0	0	0
5	2.17 – 6.12	0	0	0	0
6	2.17 – 6.12	0	0	0	0
7	2.17 – 6.12	0	0	0	0
8	2.17 – 6.12	0	0	0	0
9	2.17 – 6.12	0	0	0	0
10	2.17 – 6.12	0	0	0	0
11	2.17 – 6.12	0	0	0	0
12	2.17 – 6.12	0	0	0	0
13	2.17 – 6.12	0	0	0	0
14	2.17 – 6.12	0	0	0	0
TOTALS	**30.4 – 85.7**	**0**	**0**	**3.18**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings

2.17 – 6.12 m³/CFM

- Natural gas savings are determined from engineering calculations utilizing inputs such as air flow, indoor/outdoor temperatures, indoor/outdoor and relative humidity.

Symbols	Variable Names	Values	Source
A	Supply air flow (cfm)	ERV Capacity	UG
B	Exhaust air flow (cfm)	ERV Capacity	UG
C	Average Indoor Air Temperature (°F)	70	UG
D	Average Indoor Relative Humidity (%)	30	UG
E	Average Outside Air Temperature (°F)	Adjust Based On District	N
F	Average Outdoor Relative Humidity (%)	75	N
G	Atmospheric Pressure (psia)	14.25	UG
H	No. Of Hours in Heating Season (hrs)	Adjust Based On District	N
I2	No. Of Hours Of Operation Per Week	See Table Below	N
K	Effectiveness Of Heat Recovery Equipment (%)	67	N
L	Sensible Heat Recovery Only	no	UG
M	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of INLET Exhaust Air	Calculated	UG
N	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of INLET Supply Air	Calculated	UG
O	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of OUTLET supply Air	Calculated	UG
P	Average Temperature of OUTLET Supply Air (°F)	Calculated	UG
Q	Average Hourly Moisture Addition (lb/hr)	Calculated	UG
R	Defrost Control Derating Factor (%)	5	UG
S	Average Hourly Heat Recovery (MBH)	Calculated	UG
T	Season Efficiency of Gas-Fired Equipment (%)	82	UG
U	Average Annual Gas Reduction (m^3)	Calculated	UG
V	Incremental Natural Gas Reduction ($/$m^3$)	0.3	UG
W	Average Annual Gas Savings ($)	Calculated	UG

UG - Union Gas

N - Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010

- **NG Savings** = # of Hours in Heating Season x (operating hours/168) x Average Hourly Heat Recovery / (35.3 m^3/MJ) / (Seasonal Efficiency / 100%) **(A)**
  - 168 hour = 7 days/week x 24hours/day
  - Average Hourly Heat Recovery = Supply air flow x 60 x (Supply air flow – Inlet supply air)/Specific Supply Air Conditions Volume x (1 – Defrost Control De-rating Factor[1] %) **(B)**

[1] From Union Gas, all air-to-air heat recovery equipment requires frost control in colder climates to prevent freeze-up of exhaust air condensate on heat exchange components. Depending on the defrost control system, annual heat recovery estimates should be reduced by 5 to 15 %. Equipment manufacturers and suppliers can provide an estimated defrost derating factor given the operating conditions of the equipment.

- Operating hours for each sectors being considered are as the following

Segment	Hours of Operation per Week
Multi-Family	168
Health Care	168
Nursing Home	168
Hotel	120
Restaurant	87
Retail	73
Office	64
Warehouse	61
School	54

- Based on the NG Savings formula (A) and input assumptions above, the natural gas savings for each of the commercial sectors are calculated. Gas savings for each district were combined using a 70/30 South/North split. Markets with similar gas savings were combined to reduce administration costs and to simplify the program.

Example below:

			Existing Buildings	
Grouping	Segment	ERV Capacity (CFM)	Gas Savings (m^3)	Gas Savings per CFM (m^3/CFM)
High Use	Multi-Family Health Care Nursing Home	500	3058	6.12
Medium Use	Hotel Restaurant Retail	500	1699	3.40
Low Use	Office Warehouse School	500	1086	2.17

Annual Electricity Savings	0 kWh

N/A

Annual Water Savings	0 L/CFM

N/A

Other Input Assumptions

Effective Useful Life (EUL)	14 Years
The 14 year life recommended by DEER is based on KEMA-XENERGY's *Retention Study of PG&Es 1996-1997 Energy Incentive Program* (50). This study tracked installed equipment over 6 years and used statistical analysis to calculate EUL.[2]	
Incremental Costs	**$3.18/CFM**
The incremental costs are based on relative scaling of incremental costs $2,500 / 1000 CFM[3]. Based on communication with local contractors, the incremental costs are $3/CFM. Nexant recommends increasing the incremental cost by inflation, to $3.18/CFM.[4]	

[2] Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010, page 6-32

[3] "Prescriptive Incentives for Selected Natural Gas Technologies", Prepared for Enbridge Consumers Gas and Union Gas Ltd., by Jacques Whitford Environment Limited, Agviro Inc., and Engineering Interface Ltd., September 27, 2000.

[4] Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010, page 6-34

Heat Recovery Ventilator (HRV) – New Commercial

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description
Ventilation with HRV
Base Equipment and Technologies Description
Ventilation without HRV

Decision Type	Target Market(s)	End Use
New	Commercial	Space Heating

Codes, Standards, and Regulations

- Restriction for New Building Construction: This measure is not applicable to system ≥5,000 CFM in an application requiring ≥70% OA ratio according to Ontario Building Code 2006, because energy recovery is required.
- Restriction for New Building Construction: This measure is not applicable to systems serving health care spaces indicated in **Table 1** because heat recovery is required by CSA Z317.2-01

Table 1 - Health Care Spaces Not Eligible		
Anaesthetic gas scavenging	Cart and can washers	Areas using hazardous gases
Animal facilities	Chemical storage	Isolation rooms
Autopsy suite	Cooking facilities	Perchloric hoods
Biohazard and fume hoods	Ethylene oxide	Radioisotope hoods

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3/CFM)	Electricity (kWh)	Water (L)	($/CFM)	($)
1	1.52 – 4.28	0	0	3.61	0
2	1.52 – 4.28	0	0	0	0
3	1.52 – 4.28	0	0	0	0
4	1.52 – 4.28	0	0	0	0
5	1.52 – 4.28	0	0	0	0
6	1.52 – 4.28	0	0	0	0
7	1.52 – 4.28	0	0	0	0
8	1.52 – 4.28	0	0	0	0
9	1.52 – 4.28	0	0	0	0
10	1.52 – 4.28	0	0	0	0
11	1.52 – 4.28	0	0	0	0
12	1.52 – 4.28	0	0	0	0
13	1.52 – 4.28	0	0	0	0
14	1.52 – 4.28	0	0	0	0
TOTALS	**21.3 – 59.9**	**0**	**0**	**3.61**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	1.52 – 4.28 m^3/CFM

- HRV gas savings in new buildings is determined in the same way as in the HRV gas savings in existing buildings except the balance point temperature of a building. The balance point temperature of a building is selected based on building's thermal characteristics (internal & solar heat gains, infiltration rates and indoor temperature settings). Generally, older buildings (pre-1970's) or buildings with low internal heat gains (residences, motels, supermarkets, warehouses) should consider using a base HDD65oF or HDD60oF value. New buildings built to current OBC standards or buildings with high internal heat gains (retail, restaurants, offices) should consider using base HDD55oF, HDD50oF or even lower balance point temperature. The balance point values listed represent climate data for the London area.
- Natural gas savings are determined from engineering calculations utilizing inputs such as air flow, indoor/outdoor temperatures, indoor/outdoor and relative humidity.

Symbols	Variable Names	Values	Source
A	Supply air flow (cfm)	HRV Capacity	UG
B	Exhaust air flow (cfm)	HRV Capacity	UG
C	Average Indoor Air Temperature (°F)	70	UG
D	Average Indoor Relative Humidity (%)	30	UG
E	Average Outside Air Temperature (°F)	Adjust Based On District	N
F	Average Outdoor Relative Humidity (%)	75	N
G	Atmospheric Pressure (psia)	14.25	UG
H	No. Of Hours in Heating Season (hrs)	Adjust Based On District	N
I2	No. Of Hours Of Operation Per Week	See Table Below	N
K	Effectiveness Of Heat Recovery Equipment (%)	61	N
L	Sensible Heat Recovery Only	no	UG
M	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of INLET Exhaust Air	Calculated	UG
N	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of INLET Supply Air	Calculated	UG
O	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of OUTLET supply Air	Calculated	UG
P	Average Temperature of OUTLET Supply Air (°F)	Calculated	UG
Q	Average Hourly Moisture Addition (lb/hr)	Calculated	UG
R	Defrost Control Derating Factor (%)	5	UG
S	Average Hourly Heat Recovery (MBH)	Calculated	UG
T	Season Efficiency of Gas-Fired Equipment (%)	82	UG
U	Average Annual Gas Reduction (m^3)	Calculated	UG
V	Incremental Natural Gas Reduction ($/$m^3$)	0.3	UG
W	Average Annual Gas Savings ($)	Calculated	UG

UG - Union Gas

N - Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010

- **NG Savings** = # of Hours in Heating Season x (operating hours/168) x Average Hourly Heat Recovery / (35.3 m^3/MJ) / (Seasonal Efficiency / 100%) **(A)**
  - 168 hour = 7 days/week x 24hours/day
  - Average Hourly Heat Recovery = Supply air flow x 60 x (Supply air flow – Inlet supply air)/Specific Supply Air Conditions Volume x (1 – Defrost Control De-rating Factor[13] %) **(B)**
- Operating hours for each sectors being considered are as the following

Segment	Hours of Operation per Week
Multi-Family	168
Health Care	168
Nursing Home	168
Hotel	120
Restaurant	87
Retail	73
Office	64
Warehouse	61
School	54

- New buildings and existing buildings mainly differ in enthalpy (BTU/LBa) that is used to calculate the Specific Supply Air Conditions Volume in formula **(B).**
- Based on the NG Savings formula (A) and input assumptions above, the natural gas savings for each of the commercial sectors are calculated. Gas savings for each district were combined using a 70/30 South/North split. Markets with similar gas savings were combined to reduce administration costs and to simplify the program.

			New Buildings	
Grouping	Segment	ERV Capacity (CFM)	Gas Savings (m^3)	Gas Savings per CFM (m^3/CFM)
High Use	Multi-Family Health Care Nursing Home	500	2142	4.28
Medium Use	Hotel Restaurant Retail	500	1190	2.38
Low Use	Office Warehouse School	500	761	1.52

Annual Electricity Savings	0 kWh

N/A

Annual Water Savings	0 L/CFM

N/A

[13] From Union Gas, all air-to-air heat recovery equipment requires frost control in colder climates to prevent freeze-up of exhaust air condensate on heat exchange components. Depending on the defrost control system, annual heat recovery estimates should be reduced by 5 to 15 %. Equipment manufacturers and suppliers can provide an estimated defrost derating factor given the operating conditions of the equipment.

Other Input Assumptions

Effective Useful Life (EUL)	14 Years
The 14 year life recommended by DEER is based on KEMA-XENERGY's *Retention Study of PG&Es 1996-1997 Energy Incentive Program* (50). This study tracked installed equipment over 6 years and used statistical analysis to calculate EUL.[14]	
Incremental Costs	**$3.61 / CFM**
The incremental costs are based on relative scaling of incremental costs $1,700 / 500 CFM[15]. Nexant recommends increasing the incremental cost by inflation, to $3.61/CFM.[16]	

[14] Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010, page 6-32
[15] "Prescriptive Incentives for Selected Natural Gas Technologies", Prepared for Enbridge Consumers Gas and Union Gas Ltd., by Jacques Whitford Environment Limited, Agviro Inc., and Engineering Interface Ltd., September 27, 2000.
[16] Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010, page 6-34

Heat Recovery Ventilator (HRV) – Existing Commercial

Revision #	Description/Comment	Date Revised
		September 16, 2010

Efficient Equipment and Technologies Description
Ventilation with HRV
Base Equipment and Technologies Description
Ventilation without HRV

Decision Type	Target Market(s)	End Use
Retrofit	Existing Commercial	Space Heating

Codes, Standards, and Regulations

N/A

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3/CFM)	Electricity (kWh)	Water (L)	($/CFM)	($)
1	1.67 – 4.70	0	0	3.61	0
2	1.67 – 4.70	0	0	0	0
3	1.67 – 4.70	0	0	0	0
4	1.67 – 4.70	0	0	0	0
5	1.67 – 4.70	0	0	0	0
6	1.67 – 4.70	0	0	0	0
7	1.67 – 4.70	0	0	0	0
8	1.67 – 4.70	0	0	0	0
9	1.67 – 4.70	0	0	0	0
10	1.67 – 4.70	0	0	0	0
11	1.67 – 4.70	0	0	0	0
12	1.67 – 4.70	0	0	0	0
13	1.67 – 4.70	0	0	0	0
14	1.67 – 4.70	0	0	0	0
TOTALS	**23.4 – 65.8**	**0**	**0**	**3.61**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings — 1.67 – 4.70 m^3 / CFM

- Natural gas savings are determined from engineering calculations utilizing inputs such as air flow, indoor/outdoor temperatures, indoor/outdoor and relative humidity.

Symbols	Variable Names	Values	Source
A	Supply air flow (cfm)	HRV Capacity	UG
B	Exhaust air flow (cfm)	HRV Capacity	UG
C	Average Indoor Air Temperature (°F)	70	UG
D	Average Indoor Relative Humidity (%)	30	UG
E	Average Outside Air Temperature (°F)	Adjust Based On District	N
F	Average Outdoor Relative Humidity (%)	75	N
G	Atmospheric Pressure (psia)	14.25	UG
H	No. Of Hours in Heating Season (hrs)	Adjust Based On District	N
I2	No. Of Hours Of Operation Per Week	See Table Below	N
K	Effectiveness Of Heat Recovery Equipment (%)	61	N
L	Sensible Heat Recovery Only	no	UG
M	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of INLET Exhaust Air	Calculated	UG
N	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of INLET Supply Air	Calculated	UG
O	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of OUTLET supply Air	Calculated	UG
P	Average Temperature of OUTLET Supply Air (°F)	Calculated	UG
Q	Average Hourly Moisture Addition (lb/hr)	Calculated	UG
R	Defrost Control Derating Factor (%)	5	UG
S	Average Hourly Heat Recovery (MBH)	Calculated	UG
T	Season Efficiency of Gas-Fired Equipment (%)	82	UG
U	Average Annual Gas Reduction (m^3)	Calculated	UG
V	Incremental Natural Gas Reduction ($/$m^3$)	0.3	UG
W	Average Annual Gas Savings ($)	Calculated	UG

UG - Union Gas

N - Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010

- **NG Savings** = # of Hours in Heating Season x (operating hours/168) x Average Hourly Heat Recovery / (35.3 m^3/MJ) / (Seasonal Efficiency / 100%) **(A)**
  - 168 hour = 7 days/week x 24hours/day
  - Average Hourly Heat Recovery = Supply air flow x 60 x (Supply air flow – Inlet supply air)/Specific Supply Air Conditions Volume x (1 – Defrost Control De-rating Factor[5] %) **(B)**

[5] From Union Gas, all air-to-air heat recovery equipment requires frost control in colder climates to prevent freeze-up of exhaust air condensate on heat exchange components. Depending on the defrost control system, annual heat recovery estimates should be reduced by 5 to 15 %. Equipment manufacturers and suppliers can provide an estimated defrost derating factor given the operating conditions of the equipment.

- Operating hours for each sectors being considered are as the following

Segment	Hours of Operation per Week
Multi-Family	168
Health Care	168
Nursing Home	168
Hotel	120
Restaurant	87
Retail	73
Office	64
Warehouse	61
School	54

- New buildings and existing buildings mainly differ in enthalpy (BTU/LBa) that is used to calculate the Specific Supply Air Conditions Volume in formula **(B).**
- Based on the NG Savings formula (A) and input assumptions above, the natural gas savings for each of the commercial sectors are calculated. Gas savings for each district were combined using a 70/30 South/North split. Markets with similar gas savings were combined to reduce administration costs and to simplify the program.

Example below:

			Existing Buildings	
Grouping	Segment	ERV Capacity (CFM)	Gas Savings (m^3)	Gas Savings per CFM (m^3/CFM)
High Use	Multi-Family Health Care Nursing Home	500	2352	4.70
Medium Use	Hotel Restaurant Retail	500	1307	2.61
Low Use	Office Warehouse School	500	835	1.67

Annual Electricity Savings	0 kWh

N/A

Annual Water Savings	0 L / CFM

N/A

Other Input Assumptions

Effective Useful Life (EUL)	14 Years
The 14 year life recommended by DEER is based on KEMA-XENERGY's *Retention Study of PG&Es 1996-1997 Energy Incentive Program* (50). This study tracked installed equipment over 6 years and used statistical analysis to calculate EUL.[6]	
Incremental Costs	**$3.61 / CFM**
The incremental costs are based on relative scaling of incremental costs $1,700 / 500 CFM[7]. Nexant recommends increasing the incremental cost by inflation, to $3.61/CFM.[8]	

[6] Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010, page 6-32)

[7] "Prescriptive Incentives for Selected Natural Gas Technologies", Prepared for Enbridge Consumers Gas and Union Gas Ltd., by Jacques Whitford Environment Limited, Agviro Inc., and Engineering Interface Ltd., September 27, 2000.

[8] Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010, page 6-34

HIGH EFFICIENCY BOILERS UNDER 300 MBH

Small Commercial – New/Existing

Efficient Technology & Equipment Description
High Efficiency non-condensing boilers having annual fuel utilization efficiency (AFUE) of 85% or greater. Boiler input size is under 300,000 Btu/hr. Application is for seasonal or non-seasonal use. MBH is defined throughout this document as 1,000 Btu/hr.
Base Technology & Equipment Description
Non-condensing boiler having an AFUE of 80% for either seasonal or non-seasonal use. Boiler input size is under 300,000 Btu/hr.

Resource Savings Assumptions

Natural Gas	**Seasonal** **0.00665 m^3 /(Btu/hr Boiler Input)** **Non-Seasonal** **Boiler Input Under 100 MBH = 0.02430 m^3 /(Btu/hr Boiler Input)** **Boiler Input 100 To Under 200 MBH = 0.01491 m^3 /(Btu/hr)** **Boiler Input 200 To Under 300 MBH = 0.01115 m^3 /(Btu/hr)**

Estimation Based on Agviro Study for Enbridge

- Based on Agviro's report[1], the energy analysis compares use of a high efficiency non-condensing boiler having an AFUE of 87.5% versus a base case non-condensing boiler having an AFUE of 80%.
- The normalized gas use for a seasonal base case boiler is determined by the relationship:

$$Normalized\ Gas\ Use = 77.575 \times BoilerIP$$

where:

BoilerIP = seasonal boiler input size (MBH)
Normalized Gas Use = normalized annual seasonal gas use (m3/yr)

- The gas savings for a non-seasonal base case boiler is determined by the relationship:

$$NonSeasonal\ Gas\ Use = 36.282 \times BoilerIP + 9256.9$$

where:

BoilerIP = seasonal boiler input size (MBH)
Non Seasonal Gas Use = annual non-seasonal gas use (m3/yr)

- The gas savings of the condensing versus the base case boiler is determined by the relationship:

[1] Prescriptive Savings Analysis – Condensing Boilers Under 300MBH, Agviro Inc., Jan 17, 2011

$$GasSavings = GasUse \times (1 - \frac{\%Eff_{BC}}{\%Eff_{CE}})$$

where:

GasUse = seasonal or non-seasonal gas use (m3)
$\%Eff_{BC}$ = Efficiency of the Base Case boiler
[seasonal = 80%; non-seasonal=66.2%]
$\%Eff_{CE}$ = Efficiency of the Condensing boiler
[seasonal = 87.5%; non-seasonal=78.08%]
GasSavings = annual gas savings (m3/yr)

- On a per Btu/hr boiler input basis, the natural gas savings is:
  - seasonal boiler = 0.00665 m^3 / (Btu/hr)
  - non-seasonal boiler =
    - Boiler Input Under 100 MBH = 0.02430 m^3 /(Btu/hr Boiler Input)
    - Boiler Input 100 To Under 200 MBH = 0.01491 m^3 /(Btu/hr)
    - Boiler Input 200 To Under 300 MBH = 0.01115 m^3 /(Btu/hr)

Electricity	**0 kWh**

Water	**0 L**

Other Input Assumptions

Equipment Life	**25 yrs**

-

Incremental Cost	**Existing Construction**	
	Boiler Input (MBH)	**Incremental Cost ($)**
	Under 100	**$1,808**
	100 To Under 200	**$2,114**
	200 To Under 300	**$1,958**
	New Construction	
	Boiler Input (MBH)	**Incremental Cost ($)**
	Under 100	**$1,238**
	100 To Under 200	**$1,544**
	200 To Under 300	**$1,388**

Incremental costs account for differences in venting, controls and labour.

Incremental Cost – Existing Construction

- Boiler Input Under 100 MBH = $1,808
- Boiler Input 100 To Under 200 MBH = $2,114
- Boiler Input 200 To Under 300 MBH = $1,958

Incremental Cost – New Construction

- Boiler Input Under 100 MBH = $1,238
- Boiler Input 100 To Under 200 MBH = $1,544
- Boiler Input 200 To Under 300 MBH = $1,388

High Efficiency (Condensing) Furnace - Commercial

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description
High-efficiency condensing furnace with regular PSC motor – AFUE 96.
Base Equipment and Technologies Description
Mid-efficiency furnace AFUE 90.

Decision Type	Target Market(s)	End Use
New, Retrofit	Commercial office buildings	Space Heating

Codes, Standards, and Regulations

- Under Ontario's building code, all gas furnaces installed in new residential construction must meet a minimum condensing efficiency level effective January 1, 2007[1].
- However, effective December 31, 2009, NRCan requires the minimum performance level, or the Annual Fuel Utilization Efficiency (AFUE), for residential gas-fired furnaces with an input rate not exceeding 65.92 kW (225 000 Btu/h) to be 90%[2].

Resource Savings Table

AFUE 96

[1] Ministry of Energy, "Heating and Cooling your Home: A Conservation Guide." Reproduced with the permission of Natural Resource Canada, 2004. http://www.energy.gov.on.ca/english/pdf/conservation/heating_and_cooling_your_home.pdf
[2] Office of Energy Efficiency, Canada's Energy Efficiency Regulations, Final Bulletin, December 2008. http://oee.nrcan.gc.ca/regulations/bulletin/gas-furnaces-dec08.cfm?attr=0

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3/kBtu/h)	Electricity (kWh)	Water (L)	($/kBtu/hr)	($/kBtu/hr)
1	1.7	0	0	30.6	22.2
2	1.7	0	0	0	0
3	1.7	0	0	0	0
4	1.7	0	0	0	0
5	1.7	0	0	0	0
6	1.7	0	0	0	0
7	1.7	0	0	0	0
8	1.7	0	0	0	0
9	1.7	0	0	0	0
10	1.7	0	0	0	0
11	1.7	0	0	0	0
12	1.7	0	0	0	0
13	1.7	0	0	0	0
14	1.7	0	0	0	0
15	1.7	0	0	0	0
16	1.7	0	0	0	0
17	1.7	0	0	0	0
18	1.7	0	0	0	0
TOTALS	**30.6**	**0**	**0**	**30.6**	**22.2**

Resource Savings Assumptions

Annual Natural Gas Savings	$1.7m^3$ / kBtu / h
• Gas savings associated with upgrading from a mid-efficiency furnace to a high efficiency furnace are based on the following formula: • Annual Savings = 1 – Base Technology AFUE / Efficient Equipment AFUE = 1 – 90/96 = 6.3% • The US DOE reports a 4.91% gas savings for an AFUE 96 furnace (based on an AFUE90 baseline).[3] • Natural gas savings are based on Enbridge research[4] indicates the average consumption for a high-efficiency furnace[5] is $2,045m^3$. • Using the calculated percent savings (6.3%) multiplied by the base energy consumption (2,045 m^3) the annual gas savings are estimated to be 129 m^3. • Assuming a typical commercial furnace input of 75,000 BTU/h, natural gas savings on a per thousand BTU/h basis are 129 m^3 / 75 kBtu/h = 1.7 kBtu/h	
Annual Electricity Savings	**0 kWh**
Electricity savings resulting from high efficiency furnaces are negligible.	
Annual Water Savings	**0 L**
N/A	

Other Input Assumptions

Effective Useful Life (EUL)	18 Years
ACEEE[6] and State of Iowa[7] both estimate an effective useful life of 18 years. Puget Sound Energy[8] and New England State Program Working Group (SPWG)[9] also suggest 18 years for high efficiency furnaces.	
Base & Incremental Conservation Measure Equipment and O&M Costs	**$8.4/ kBtu / h**
Average incremental cost is based on communication with local HVAC contractors. Navigant Consulting is assuming that the ratio of the incremental cost between a commercial AFUE 90 furnace and a commercial AFUE 96 furnace is the same as for residential market (38%). Therefore, using a baseline commercial AFUE 90 furnace of $3,000, the incremental cost i is estimated to be $1,135 for a 135,000 Btu/hr furnace, or $8.4.5/kBtu/hr.	
Customer Payback Period (Natural Gas Only)[10]	**9.6 Years**
Using an 5-year average commodity cost (avoided cost)[11] of $0.36/ m^3 and an average commercial distribution cost[12] of $0.14 / m^3, the payback period for natural gas savings is determined to be 9.6	

[3] US DOE Residential Furnaces and Boilers Technical Support Document Analytical Tools. Life Cycle Cost Results for Non-Weatherized Gas Furnaces. http://www1.eere.energy.gov/buildings/appliance_standards/residential/docs/lcc_nwgf_gt6000hdd.xls
[4] Based on information provided by Enbridge Gas, based on Decision for the Enbridge 2006 DSM Plan (EB2005-0001).
[5] Average commercial baseline consumption for a mid-efficiency furnace was not available from either of the Ontario gas utilities, therefore, residential baseline furnace consumption will be used and computed on a per thousand Btu/h basis.
[6] Powerful Priorities: Updating Energy Efficiency Standards for Residential Furnaces, Commercial Air Conditioners, and Distribution Transformers. ACEEE, September 2004.
[7] Joint Assessment Study, MidAmerican Energy Company, Appendix C. State of Iowa Utilities Board Docket No. EEP-08-2, 2008, C-131
[8] Quantec, Comprehensive Demand-Side Management Resource Assessment, Prepared for Puget Sound Energy, May 2007
[9] GDS Associates, Inc., Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, Prepared for The New England State Program Working Group (SPWG), For use as an Energy Efficiency Measures/Programs Reference Document for the ISO Forward Capacity Market (FCM), June 2007
[10] Customer payback period has been calculated using natural gas savings only. Where applicable, payback period is expected to decrease when electricity and/or water savings are included.

years, based on the following:

Payback Period = Incremental cost / (natural gas savings x natural gas cost)
= $8.4/kBtu/hr / (1.7m^3/kBtu/hr/year* $0.50 / m^3)
= 9.6 Years

Market Share[13]	Medium

Based on market share information for residential furnaces[14], Navigant Consulting is assuming a similar trend for the commercial sector. Therefore, Navigant Consulting estimates the market share in Ontario to be medium.

Measure Assumptions Used by Other Jurisdictions

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
Questar Gas, 2006[15]	841.5	20	487.5	N/A
Comments Questar Gas reported 30.6 DTH annual natural gas savings, which translates to 841.5 m^3.				
Puget Sound Energy[16]	0.0396 m^3/sq.ft.	20	$0.1/sq.ft.	N/A
Comments Puget Sound reports 12% savings based on a baseline gas furnace of AFUE 75 and energy efficient furnace of AFUE 85. Baseline usage is 0.12 therms/sq.ft., therefore savings is 12% x 0.12 therms/sq.ft. x 2.75 m^3/therm = 0.0396 m^3 /sq.ft.				

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11 2009 Avoided gas cost provided by Union Gas. 5 year average avoided gas cost determined by taking average for baseload and weather sensitive avoided gas cost.
12 Average distribution cost taken calculated from both Union Gas website (http://www.uniongas.com/residential/rates/) and Enbridge Gas websites (https://portal-plumprod.cgc.enbridge.com/portal/server.pt?open=512&objID=248&PageID=0&cached=true&mode=2&userID=2).
13 Navigant Consulting is defining "Low" as below 5%, "Medium" as between 5-50%, and "High" as above 50%,
14 NRCan, Office of Energy Efficiency, Comprehensive Energy Use Database: Table 22: Single detached heating system stock by heating system type, http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/trends_res_on.cfm, updated September 2008.
15 Nexant, Questar Gas DSM Market Characterization Report, 2006
16 Quantec, Comprehensive Demand-Side Management Resource Assessment, Prepared for Puget Sound Energy, May 2007

Infrared Heaters, UG & EGD

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description
Infrared heater (up to 255,000 Btu/hour)
Base Equipment and Technologies Description
Regular unit heater

Decision Type	Target Market(s)	End Use
New/Retrofit	New/Existing Commercial buildings	Space Heating

Codes, Standards, and Regulations

The old code CAN 1-2.16-M81 (R1996) has been withdrawn.

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3/Btu/hour)	Electricity (kWh)	Water (L)	($/Btu/hour)	($)
1	0.0159	16 - 873	0	0.0122	0
2	0.0159	16 - 873	0	0	0
3	0.0159	16 - 873	0	0	0
4	0.0159	16 - 873	0	0	0
5	0.0159	16 - 873	0	0	0
6	0.0159	16 - 873	0	0	0
7	0.0159	16 - 873	0	0	0
8	0.0159	16 - 873	0	0	0
9	0.0159	16 - 873	0	0	0
10	0.0159	16 - 873	0	0	0
11	0.0159	16 - 873	0	0	0
12	0.0159	16 - 873	0	0	0
13	0.0159	16 - 873	0	0	0
14	0.0159	16 - 873	0	0	0
15	0.0159	16 - 873	0	0	0
16	0.0159	16 - 873	0	0	0
17	0.0159	16 - 873	0	0	0
18	0.0159	16 - 873	0	0	0
19	0.0159	16 - 873	0	0	0
20	0.0159	16 - 873	0	0	0
TOTALS	**0.32**	**326 – 17,469**	**0**	**0.0122**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings — 0.0159 m^3 / Btu/ h

The infrared heater gas savings were based on the analysis procedures previously created by Agviro Inc. for Union Gas[1].

Savings in the Agviro report are provided in three bins, corresponding to the input rating (Btu/hour) of the 0% over-sized conventional draft hood unit heater to be replaced. Agviro explicitly notes that over-sizing was not taken into account in the calculation of savings.

Agviro also notes that the efficient technology, the infrared heater "has been downsized by the infrared adjustment factor" and that "[when/if] the conventional system is 75,000 btu/h input... the infrared heater is [approximately] 64,000 Btu/h input...."

Put another way, an IR heater replacing a 0% over-sized conventional draft hood heater will have an input in btu/h that is 85% (the IR adjustment factor) that of the conventional unit.

Rather than using input range bins for the conventional draft hood heater, Navigant recommends using the corresponding input range bins for the efficient technology. This is for two reasons:

1. It will likely be much simpler to determine the input (btu/h) of the replacement/efficient technology than of the old conventional heater to be replaced.
2. The savings will not be overstated regardless of whether or not the conventional unit is over-sized, so long as the IR heater is appropriately sized for the heating load to be served. If in fact the conventional unit is over-sized the savings estimated will likely be understated given that an oversized draft hood heater operating at partial capacity is likely to consume more gas for a given heating load than a 0% oversized draft hood heater operating at optimal capacity.

In summary: the input heater range bins (and the attendant savings) shown below correspond to the input of *the efficient measure*.

Location	Heater Range (Btu/h)	Annual Gas Savings (m^3/year)		
		Single Stage	2-Stage	High Intensity
London	0 – 63,750	898	1,508	898
	64,600 – 127,500	1,786	3,017	1,786
	128,350 - 255,000	3,591	6,033	3,591
Sudbury	0 – 63,750	971	1,631	971
	64,600 – 127,500	1,942	3,262	1,942
	128,350 - 255,000	3,883	6,524	3,883

Annual gas savings were determined by taking the difference in the annual natural gas consumption of a conventional system and the annual natural gas consumption of the efficient technology as in equation (1) below.

$$\Delta GasUse = \left(\frac{AnnualHeatLoss_{Conv}}{Eff_{Conv}} - \frac{AnnuaHeatLoss_{EE}}{Eff_{EE}} \right) \times \frac{1}{35,300} \quad (1)$$

Where:

$AnnualHeatLoss =$ Annual heat loss of conventional heater and EE infrared heater (as

[1] Assessment of Average Infrared Heater Savings, Agviro, December 1, 2004

defined by subscript).

Eff = The combustion efficiency of the heater (%).

35,300 = The energy value of natural gas (Btu/m^3)

The annual heat loss is calculated by Agviro as the sum of unit heat losses in a variety of outdoor temperature bins each of which is multiplied by the number of hours in which the temperature, on average falls into a given bin[2].

An average rate of savings of 0.0159 m^3/Btu/hour was determined by taking a weighted average of the savings from both locations: 70% of Union Gas South (London) and 30% of Union Gas North (Sudbury) based on customer population distribution in Union Gas service territories. Navigant, in determining the average rate of savings from the information in the Agviro report has conservatively assumed that the Btu/h is the highest possible for a given range. For example, a single-stage infrared heater saves on average 920 m^3 of natural gas per year (see table directly below) for Infrared heaters in the 0 – 63,750 Btu/h range – the weighted average between Union's two territories. Assuming that the average Btu/h within this range is in fact the highest possible value in this range (in this case 63,750 Btu/h) this results in savings of 0.0144 m^3/Btu/hr/year as shown in the table below.

The savings associated with the different types of IR heaters were then averaged using market share weightings, resulting in 0.0159 m^3/Btu/hr/year.[3]

Capacity (Btu/h)	Single stage	2 Stage	High Intensity	Average
63,750	920	1,545	920	1,128
127,500	1,833	3,091	1,833	2,252
250,000	3,679	6,180	3,679	4,513
Infrared Tier	Revised Calculation			Average
63,750	0.0144	0.0242	0.0144	0.0177
127,500	0.0144	0.0242	0.0144	0.0177
255,000	0.0144	0.0242	0.0144	0.0177
Weighted by Navigant market estimate				
Capacity (Btu/h)	79%	15%	6%	**Average**
63,750	0.0114	0.0036	0.0009	**0.0159**
127,500	0.0114	0.0036	0.0009	**0.0159**
255,000	0.0114	0.0036	0.0009	**0.0159**

Annual Electricity Savings | 16 - 873 kWh

Both infrared heaters and conventional draft-hood unit heaters require an electrically powered circulating fan. Infrared heaters typically use a fan of a much lower horse-power than those used by a conventional draft-hood heater.

Navigant has estimated the base measure's fan load by converting the average fan horse-power of a representative sample of conventional draft-hood heaters[4] into kilowatts. Fan loads for infrared heaters

[2] Ibid.

[3] As agreed to in the 2010 audit. Data from The Cadmus Group, Inc., "Independent Audit of 2010 DSM Program Results – Report", July 2011, pg 13.

[4] Horse-powers are drawn from Trane's specifications sheet for that company's line of conventional draft-hood heaters: http://www.trane.com/Commercial/Uploads/Pdf/1024/uh-ts-1.pdf

were obtained by Navigant by contacting several manufacturers by and requesting the horse-power of the fan/blower on the most popular units in a given btu/hr input range[5].

As with the natural gas savings shown above, the electricity savings correspond to the input range bin in which the input (btu/h) of the efficient technology falls, not the base technology.

	Fan load (kW)		Operating Hours per Year		
Heater Range (Btu/h)	Conventional draft-hood heater	Infrared Heater	Conventional draft-hood heater	Infrared Heater	**Electricity Savings**
< 50,000	0.02	0.02	2509	2133	**16**
50,000 - 165,000	0.19	0.04	2509	2133	**409**
> 165,000	0.43	0.09	2509	2133	**873**

Annual Water Savings	0 L

N/A

Other Input Assumptions

Effective Useful Life (EUL)	20 Years

Infrared heaters have an estimated service life of 20 years[6].

Base & Incremental Conservation Measure Equipment and O&M Costs	$ 0.0122 / Btu / h

An incremental cost of $350 was used based on past input assumptions filed by Union[7]. Local retailers reported an average of $0.009 / Btu/hr incremental cost. Navigant Consulting therefore is estimating an average of $0.0122 / Btu/hour.

Measure Assumptions Used by Other Jurisdictions

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
Questar Gas[8]	32.64	17	1,391	N/A

Comments
Specifications for infrared heaters are not provided in the report or the baseline assumptions.

[5] Navigant contacted Spaceray (www.spaceray.com) , Schwank (www.schwankgroup.com) and Calcana (www.Calcana.com) and also consulted the online specifications published by Solaronics (http://solaronics.thomasnet.com/Asset/SSTG-SSTU-GB_200010_Spec_Sheet.pdf). The infrared heaters produced by Solaronics, Schwank and Spaceray all use the same horse-power fan, regardless of btu/hr input, whereas the Calcana heater fan horse-power varies by input range. Navigant has conservatively assumed that the fan load of the 0 – 75,000 btu/hr range will be the average of all those reported to Navigant, whereas the fan-load for the other two buckets will be those reported by Calcana.

[6] "Prescriptive Incentives for Selected Natural Gas Technologies", Prepared for Enbridge Consumers Gas and Union Gas Ltd., Prepared by: Jacques Whitford Environment Limited, Agviro Inc., and Engineering Interface Ltd., September 27, 2000.

[7] EB-2005-0211, Union Gas Settlement Agreement, April 7, 2005

[8] Questar Gas, DSM Market Characterization Report, by Nexant, August 9, 2006

HIGHER EFFICIENCY BOILERS –SPACE HEATING

Existing and New Commercial and Multi- Residential

Efficient Technology & Equipment Description
Hydronic Boilers for space (Seasonal)
Base Technology & Equipment Description
80% Combustion Efficiency Space Heating Boiler

Resource Savings Assumptions

Natural Gas (Updated)

Boiler Size	**Space Heating (Seasonal) M3 Savings by Combustion Efficiency 83-84%**	**85-88%**
300 MBH	**2,105**	**3,125**
600 MBH	**3,994**	**5,930**
1,000 MBH	**7,310**	**10,856**
1,500 MBH	**11,554**	**17,157**
2,000 MBH	**16,452**	**24,431**

Source: Prescriptive Commercial Boiler Program – Prescriptive Savings Analysis – Agviro Report Sept 10, 2008.

An iterative approach was used to determine the annual savings in the commercial sector. The following steps were taken:
a. The Rate 6 accounts were subdivided into bins of annual gas use. This provided the annual average gas use, number of accounts, seasonal, non-seasonal and total gas use.
b. The seasonal portion of the annual gas use was normalized to 30 year weather data. This normalized gas use was correlated to a seasonal boiler size required for gas consumption.
c. Categories of boiler sizes were selected to provide a suitable range of boilers available within the sector.
d. The Rate 6 accounts were subdivided using the normalized average seasonal gas use for the respective categories of boilers selected. This provided the annual average gas use, number of accounts, and total gas use per seasonal boiler size category.
e. Seasonal annual gas use normalization of the boiler size category accounts was completed.
f. Annual seasonal efficiency of the boiler size categories for each of the combustion efficiency ranges was determined.
g. Boiler costs for the boiler size categories was compiled.
h. A TRC analysis was completed for each of the boiler size categories.
i. A similar approached was used for the non-seasonal gas use with the exception of normalizing the data.

Electricity (Updated)	**kWh**
Water	**L**

Other Input Assumptions

Equipment Life	**25 years**
As per EB 2008-0384 & 0385	
Incremental Cost (Contr. Install)	**Space Heating (Seasonal) Incremental Cost by Combustion Efficiency**
	Boiler Size / **83-84%** / **85-88%**
	300 MBH / **$3,900** / **$ 4,500**
	600 MBH / **$5,800** / **$ 6,000**
	1,000 MBH / **$7,400** / **$10,300**
	1,500 MBH / **$5,900** / **$ 7,400**
	2,000 MBH / **$4,950** / **$ 7,050**
Source: Prescriptive Commercial Boiler Program – Prescriptive Savings Analysis – Agviro Report Sept 10, 2008.	
Free Ridership	**Enbridge** **Small Commercial 10%** **Large Commercial 12%** **Multi-Family 20%**
As per EB 2008-0384 - 0385	

PRESCRIPTIVE SCHOOL BOILERS - ELEMENTARY

Commercial Existing Buildings

Efficient Technology & Equipment Description
Space Heating, Hydronic Boiler with Combustion Efficiency of 83% or higher
Base Technology & Equipment Description
Space Heating, Hydronic Boiler with Combustion Efficiency of 80% to 82%.

Resource Savings Assumptions

Natural Gas	**10,830 m^3**
As recommended by Navigant and approved in EB-2008-0384 / 0385.	
Electricity	**N/A kWh**
Water	**N/A L**

Other Input Assumptions

Equipment Life	**25 years**
As recommended by Navigant and approved in EB-2008-0384 / 0385.	
Incremental Cost (Contractor Install)	**$8,646**
Source: Elementary Schools Prescriptive Savings Analysis Report, Agviro Inc., November 23, 2007. Incremental costs are based on the weighted average of boiler types as noted above. As approved in EB-2008-0384 & 0385.	
Free Ridership (EGD/UG)	**12% / 27%**
As recommended in Summit Blue and approved in EB 2008-0384 & 0385.	

PRESCRIPTIVE SCHOOL BOILERS - SECONDARY

Commercial Existing Buildings

Efficient Technology & Equipment Description -
Space Heating, Hydronic Boiler with Combustion Efficiency of 83% or higher
Base Technology & Equipment Description
Space Heating, Hydronic Boiler with Combustion Efficiency of 80% to 82%.

Resource Savings Assumptions

Natural Gas	**43,859 m^3**
As recommended by Navigant and approved in EB-2008-0384 / 0385.	
Electricity	**N/A kWh**
Water	**N/A L**

Other Input Assumptions

Equipment Life	**25 years**
As recommended by Navigant and approved in EB-2008-0384 / 0385.	
Incremental Cost (Contractor Install)	**$14,470**
Source: Secondary Schools Prescriptive Savings Analysis Report, Agviro Inc., November 23, 2007. Incremental costs are based on the weighted average of boiler types as noted above. As approved in EB-2008-0384 & 0385	
Free Ridership (EGD)	**12% / 27%**
As recommended in Summit Blue and approved in EB 2008-0384 & 0385.	

Programmable Thermostat - Commercial

Revision #	Description/Comment	Date Revised
		September 29, 2010

Efficient Equipment and Technologies Description

Programmable thermostat assuming full set-back.

Base Equipment and Technologies Description

Standard non-programmable thermostat.

Decision Type	Target Market(s)	End Use
Existing	Commercial	Space heating

Codes, Standards, and Regulations

- To be an Energy Star®-qualified programmable thermostat, the device must have at least two different programming periods, four possible temperature settings and allow for temporary user-override.
- CSA C828-99- CAN/CSA Performance Requirements for Thermostats

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	10 - 132	8 – 87			
2	10 - 132	8 – 87			
3	10 - 132	8 – 87			
4	10 - 132	8 – 87			
5	10 - 132	8 – 87			
6	10 - 132	8 – 87			
7	10 - 132	8 – 87			
8	10 - 132	8 – 87			
9	10 - 132	8 – 87			
10	10 - 132	8 – 87			
11	10 - 132	8 – 87			
12	10 - 132	8 – 87			
13	10 - 132	8 – 87			
14	10 - 132	8 – 87			
15	10 - 132	8 – 87			
TOTALS	**144 – 1,984**	**127 – 1,301**	**0**	**$110**	

Resource Savings Assumptions

Annual Natural Gas Savings	10 – 132 m^3

The online Energy Star® spreadsheet calculator for programmable thermostats suggests that for every degree Fahrenheit in temperature reduction there is a 3% reduction in space-heating natural gas consumption.

Union Gas estimates that, corrected for the average outdoor heating season temperature, for every degree Fahrenheit in temperature reduction there is a 2.4% reduction in natural gas consumption in southern and central Ontario and a 2.05% reduction in natural gas consumption in northern Ontario[1]. The weighted average percentage savings, based on Enbridge's overall distribution of customers (80% Central, 20% Eastern) is 2.33%.

Given the climatic similarity between Union's northern Ontario (North Bay) territory and Enbridge's eastern territory (Ottawa) and the climatic similarity between Union's south/central territory (London) and Enbridge's central territory (Toronto), Navigant has assumed that gas savings would not substantially differ between Union's northern and Enbridge's eastern territories or between Union's south/central and Enbridge's central territories.

Under the assumption that full thermostat setback is 8 degrees Fahrenheit[2] this implies that for every hour in which the thermostat is fully set back, there is an 18.64% reduction in space-heating natural gas consumption.

It is likely that not all commercial customers will practice full set-back, and it is also likely that some percentage of commercial customers already practice manual set-back with a non-programmable thermostat. No robust data-set exists for Ontario that tracks this behaviour for commercial natural gas customers.

As a proxy, Navigant has used the results of a survey conducted as part of Navigant's evaluation of the Ontario Power Authority's (OPA) Hot and Cool Savings program, which asked participants about how they habitually set their thermostat both before and after obtaining a programmable thermostat. Residential customers that set back their thermostats an additional three or more degrees Celsius are assumed to be a proxy for the percentage of commercial customers that practiced full set-back as outlined by the Energy Star calculator (i.e., 8 degrees Fahrenheit). Residential customers that set back their thermostats an additional 1 – 3 degrees Celsius only are assumed to be a proxy for the percentage of commercial customers that practiced half of the full set-back as outlined by the Energy Star calculator (i.e., 4 degrees Fahrenheit).

Table 1 – Space-Heating Behaviour Change

Behaviour		Sub-Behaviour, With Programmable T-Stat	
Practiced Manual Set-Back	40%	No additional set-back	73%
		Additional full set-back	9%
		Additional partial set-back	19%
Did Not Practice Manual Set-Back	50%	No additional set-back	44%
		Additional full set-back	20%
		Additional partial set-back	35%
Data Not Available (Refused to Answer)	10%	N/A	N/A
		N/A	N/A
		N/A	N/A

Note that in some cases values may add to more or less than 100% due to rounding error

Navigant notes that the above distribution is very conservative. It is highly unlikely that those responding to

[1] Based on average temperatures in London, Ontario and North Bay, respectively. Estimated by Union Gas based on the 3% savings for the Energy Star calculator, adjusted by temperature norms in Union Gas territories. Drawn from Union Gas' March 13, 2009 response to Navigant's initial draft of *Measures and Assumptions For Demand Side Management* prepared for the Ontario Energy Board.

[2] Energy Star Calculator assumption. U.S. DOE, *Programmable Thermostat Tool*, http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=TH

the survey that practice manual thermostat set-back do so punctually every single evening of the year during the heating season. There are almost certainly incremental savings not captured in this sheet due to the automation of thermostat set-back amongst those that practice manual set-back. Lacking firm empirical data, however, these savings cannot accurately be estimated and are thus not included.

The Hot and Cool Savings findings in the table above (excluding those that did not answer the survey questions) imply:

Table 2 – Aggregated Behaviour and Savings

Implied Overall Behaviour (Excluding Those That Refused to Answer)	Distribution of Households	Natural Gas Savings
No additional set-back	57%	0%
Additional full set-back	15%	18.64%
Additional partial set-back	28%	9.32%

The average natural gas savings per business on any given hour when the temperature is set back may therefore be calculated as: 57% x 0% + 15% x 18.64% + 28% x 9.32% = 5.41%

This percentage saving may then be applied to

a. All hours in which it is expected that the thermostat could be set back for a given market segment
b. The space-heating energy intensity of that market segment
c. The area of a building in that market segment which may reasonably be supposed to be controlled by an individual programmable thermostat.

The setback duration (a., above) has been estimated by Navigant and is shown in Table 3, below.

The energy intensity of each market segment, except Small Fitness/Spa[3], (b., above) has been drawn from a Marbek report recently completed for Enbridge Gas[4] and is shown in Table 3, below. The energy intensities used in Table 3 below are a weighted average based on the distribution of Enbridge customers between the Central and Eastern zones (80% Central, 20% Eastern).

The thermostat control area (c., above) has been provided by Union Gas based on internal research done by Union Gas staff and provided to Navigant and is shown in Table 4, below.

The segments identified by Marbek and those identified by Union Gas were mapped to each other as shown in Table 4, below.

Not all segments identified by Marbek are included. Some segments (e.g., Large Offices) identified by Marbek generally have large-scale central controls for temperature settings and do not make use of individual thermostats, programmable or otherwise.

[3] This intensity was drawn from table C24 of the 2003 CBECS tables published the U.S. DOE and calibrated to Ontario's climate through a comparison with other CBECs intensities and those found in the Marbek report.

[4] Marbek Resource Consultants, *Natural Gas Energy Efficiency Potential: Update 2008 Commercial Sector*, May 2009

Table 3 – Annual Gas Savings per ft^2

Marbek Segment	Times in which thermostat set-back is possible	% of Time Set-Back Possible	% Savings	Energy Intensity (m^3/ft^2)	Gas Savings (m^3/ft^2)
Warehouse / Wholesale	12 hours/weekday & Sat, 24 hours Sunday	57%	3.1%	1.43	0.04
Small Office	12 hours/weekday, 24 hours weekends	64%	3.5%	1.72	0.06
Strip Mall	7 hours/night	29%	1.6%	1.18	0.02
Non-food retail (Mall)	7 hours/night	29%	1.6%	1.46	0.02
Food Retail	7 hours/night	29%	1.6%	2.30	0.04
Restaurant/Tavern	7 hours/night	29%	1.6%	3.74	0.06
Large Hotel	7 hours/night	29%	1.6%	1.43	0.02
Motel/Hotel	7 hours/night	29%	1.6%	1.32	0.02
School	12 hours/weekday, 24 hours weekends	64%	3.5%	1.91	0.07
University/College	12 hours/weekday, 24 hours weekends	64%	3.5%	1.71	0.06
Small Fitness/Spa	5 hours/night	21%	1.1%	1.24	0.01

Table 4 - Annual Gas Savings per Thermostat, by Segment

Union Gas Market Segment	Marbek Segment	Area of Thermostat Control Zone (ft^2)	Gas Savings (m^3/ft^2)	Annual Gas Savings (m^3/per thermostat)
Warehouse	Warehouse / Wholesale	3000	0.04	132
Office	Small Office	650	0.06	39
Retail	Strip Mall	600	0.02	11
Retail	Non-food retail (Mall)	600	0.02	14
Retail	Food Retail	600	0.04	22
Food Service	Restaurant/Tavern	1175	0.06	69
Hotels/Motels	Large Hotel	461	0.02	10
Hotels/Motels	Motel/Hotel	461	0.02	10
Educational Services	School	986	0.07	65
Educational Services	University/College	986	0.06	58
Recreation	Small Fitness/Spa	2500	0.01	35

Annual Electricity Savings	8 – 87 kWh

The online Energy Star® spreadsheet calculator for programmable thermostats suggests that for every degree Fahrenheit in temperature increase there is a 6% reduction in space cooling electricity consumption.

Under the assumption that full thermostat setup is 4 degrees Fahrenheit (from 74^{o} to 78^{o}F), this implies that for every hour in which the thermostat is set back, there is an 24% reduction in space-cooling electricity consumption.

It is likely that not all commercial customers will practice full set-back, and it is also likely that some percentage of commercial customers already practice manual set-back with a non-programmable thermostat. No robust data-set exists for Ontario that tracks this behaviour for commercial natural gas customers.

As a proxy, Navigant has used the results of a survey conducted as part of Navigant's evaluation of the Ontario Power Authority's (OPA) Hot and Cool Savings program, which asked participants about how they habitually set their thermostat after receiving a programmable one. Unfortunately participants (unlike for heating) were not asked to what temperature they set their thermostat to prior to having the programmable thermostat. Residential customers that set up their thermostats an additional three or more degrees Celsius are assumed to be a proxy for the percentage of commercial customers that practiced full set-up as outlined by the Energy Star calculator (i.e., 4 degrees Fahrenheit). Residential customers that set up their thermostats an additional 1 – 3 degrees Celsius only are assumed to be a proxy for the percentage of commercial customers that practiced half of the full set-up as outlined by the Energy Star calculator (i.e., 2 degrees Fahrenheit).

Table 5 - Space Cooling Behaviour Change

Thermostat set-back	Distribution of Households	Electricity Savings
No additional thermostat set-back	64%	0%
3 or more additional degrees set-back	13%	24%
1 - 3 additional degrees set-back	22%	12%

The average electricity savings per business on any given hour when the temperature is set up may therefore be calculated as: 64% x 0% + 13% x 24% + 22% x 12% = 5.87%

This percentage saving may then be applied to

a. All hours in which it is expected that the thermostat could be set up for a given market segment
b. The space-cooling energy intensity of that market segment
c. The area of a building in that market segment which may reasonably be supposed to be controlled by an individual programmable thermostat.
d. The market saturation (incidence of A/C) of central air-conditioning for a given market segment[5].

The setback duration (a., above) has been estimated by Navigant and is shown in Table 5, below.

The energy intensity of each market segment, except Small Fitness/Spa[6], segment (b., above) has been drawn from a Marbek report recently completed for Enbridge Gas[7] and is shown in Table 5, below. The energy intensities used in Table 6below are a weighted average based on the distribution of Enbridge customers between the Central and Eastern zones (80% Central, 20% Eastern).

The thermostat control area (c., above) has been provided by Union Gas based on internal research done by Union Gas staff and provided to Navigant and is shown in Table 6, below.

The segments identified by Marbek and those identified by Union Gas were mapped to each other as

[5] While there will of course be no electricity savings when this device is installed in a building without central air-conditioning, it is assumed that these devices will be installed in a representative sample of the population for that segment, thus making the average electricity savings per thermostat a function of the percent of the population in question that has central air-conditioning.

[6] Since the Marbek report does not include a space cooling energy intensity or A/C saturation for this segment, Navigant has assumed that both of these will be approximately the average of the space cooling intensity and A/C saturation of the Non-food Retail and Restaurant/Tavern segments.

[7] Marbek Resource Consultants, *Natural Gas Energy Efficiency Potential: Update 2008 Commercial Sector*, May 2009.

shown in Table 6, below.

The market saturation of central air-conditioning of each market segment, except Small Fitness/Spa (d. above) has been drawn from a Marbek report recently completed for Enbridge Gas[8] and is shown in Table 5, below. The saturations used are the weighted average of the Central and Eastern zone saturations, based on the distribution of Enbridge customers by zone (80% Central, 20% Eastern).

Not all segments identified by Marbek are included. Some segments (e.g., Large Offices) identified by Marbek generally have large-scale central controls for temperature settings and do not make use of individual thermostats, programmable or otherwise.

Table 6 – Annual Electricity Savings per ft^2

Marbek Segment	Times in which thermostat set-back is possible	% of Time Set-Back Possible	Space Cooling Market Saturation	% Savings	Energy Intensity (kWh/ft^2)	Electricity Savings (kWh/ft^2)
Warehouse / Wholesale	12 hours/weekday & Sat, 24 hours Sunday	57%	10%	0.3%	0.90	0.003
Small Office	12 hours/weekday, 24 hours weekends	64%	86%	3.2%	2.06	0.07
Strip Mall	7 hours/night	29%	85%	1.5%	2.18	0.03
Non-food retail (Mall)	7 hours/night	29%	85%	1.5%	2.18	0.03
Food Retail	7 hours/night	29%	80%	1.4%	1.98	0.03
Restaurant/Tavern	7 hours/night	29%	85%	1.5%	4.50	0.07
Large Hotel	7 hours/night	29%	85%	1.5%	2.12	0.03
Motel/Hotel	7 hours/night	29%	85%	1.5%	1.68	0.02
School	12 hours/weekday, 24 hours weekends	64%	15%	0.6%	1.52	0.01
University/College	12 hours/weekday, 24 hours weekends	64%	75%	2.8%	2.04	0.06
Small Fitness/Spa	5 hours/night	21%	85%	1.0%	3.34	0.03

[8] Marbek Resource Consultants, *Natural Gas Energy Efficiency Potential: Update 2008 Commercial Sector*, May 2009.

Table 7 - Annual Electricity Savings per Thermostat, by Segment

Union Gas Market Segment	Marbek Segment	Area of Thermostat Control Zone (ft^2)	Electricity Savings (kWh/ft^2)	Annual Electricity Savings (kWh/ per thermostat)
Warehouse	Warehouse / Wholesale	3000	0.003	9
Office	Small Office	650	0.07	43
Retail	Strip Mall	600	0.03	19
Retail	Non-food retail (Mall)	600	0.03	19
Retail	Food Retail	600	0.03	16
Food Service	Restaurant/Tavern	1175	0.07	77
Hotels/Motels	Large Hotel	461	0.03	14
Hotels/Motels	Motel/Hotel	461	0.02	11
Educational Services	School	986	0.01	8
Educational Services	University/College	986	0.06	57
Recreation	Small Fitness/Spa	2500	0.03	87

Annual Water Savings	**0 L**

N/A

Other Input Assumptions

Effective Useful Life (EUL)	**15 Years**

Navigant has assumed the effective useful life of this measure to be fifteen years, in accordance with that given on the Energy Star® web-site.

Incremental Costs	**$110**

Navigant has assumed that the average incremental cost of a commercial-grade programmable thermostat is $110 based on the on-line price for the Honeywell MULTIPRO Commercial Thermostat.

Programmable Thermostat – Multi-Residential

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description
Programmable thermostat.
Base Equipment and Technologies Description
Standard thermostat.

Decision Type	Target Market(s)	End Use
Existing	Existing Multi-Residential	Space Heating

Codes, Standards, and Regulations

- For a programmable thermostat to receive Energy Star® qualification, it must meet specific criteria such as having at least two different programming periods (for weekday and weekend programming), at least four possible temperature settings and allow for temporary overriding by the user.
- In Canada, applicable CSA standards can be found in CSA C828-99- CAN/CSA Performance Requirements for Thermostats used with Individual Room Electric Space Heating Devices.

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	15	13	0	80	0
2	15	13	0	0	0
3	15	13	0	0	0
4	15	13	0	0	0
5	15	13	0	0	0
6	15	13	0	0	0
7	15	13	0	0	0
8	15	13	0	0	0
9	15	13	0	0	0
10	15	13	0	0	0
11	15	13	0	0	0
12	15	13	0	0	0
13	15	13	0	0	0
14	15	13	0	0	0
15	15	13	0	0	0
TOTALS	**225**	**195**	**0**	**80**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	15 m^3

- The savings calculated below for a household living in a multi-residential dwelling (i.e., an apartment) are predicated on the assumption that the occupants of the dwelling are responsible for paying for the natural gas they use and thus subject to the economic incentive to actually program the thermostat.
- Two utility studies[1] are used to determine savings resulting from residential programmable thermostats on natural gas consumptions.

  - In the ***GasNetworks*** study[2], 4,061 mail-in surveys and bills were analyzed. Results were normalized for temperature and the energy impacts were determined through a multivariate regression analysis. The study found that programmable thermostat saved 6 % of total household annual natural gas use. GasNetworks is proposing 75 ccf (212 m^3) natural gas savings based on a Non-Programmable Thermostat annual consumption of 1,253 ccf (3,548 m^3) natural gas.
  - In the ***Enbridge Billing Analysis***[3], 911 customers' natural gas consumption was analyzed in 2005. Enbridge determined an average savings of 159 m^3 for a house using 2,878 m^3 of natural gas.

- Canadian Centre for Housing Technology (CCHT) also conducted a study in 2005 on programmable thermostat natural gas savings[4]. The study was done in two identical research homes located in Ottawa to allow direct comparison of changes in operating conditions in a home. It reports a 6.5% predicted savings for 18°C night setback.
- Based on these three studies, Navigant is assuming an average saving at 6% for natural gas consumptions for full temperature set back in single-family homes.

Table 1 - Gas Savings From Previous Studies

Studies	Baseline Gas Consumption (m^3)	Gas Savings (m^3)	Gas Savings%
GasNetworks (2007)	3,548	212	6.0%
Enbridge (2005)	2,878	159	5.5%
CCHT (2005)	-	-	6.5%
NCI Average			6.0%

- Applying the 6% savings estimated above for single-family homes to multi-family homes would require that multi-family household space-heating natural gas use is the same proportion of total multi-family household natural gas use as single-family household space-heating natural gas use is of total single family household natural gas use. An examination of NRCan data[5] implies that this is not, in fact, the case.

[1] "Resource Savings Values in Selected Residential DSM Prescriptive Programs", Summit Blue Consulting, June 2008.
[2] RLW Analytics, Validating the impact of programmable thermostats: final report. Prepared for GasNetworks by RLW Analytics. Middletown, CT, January 2007.
[3] "Resource Savings Values in Selected Residential DSM Prescriptive Programs", Summit Blue Consulting, June 2008.
[4] The Effects of Thermostat Setting on Seasonal Energy Consumption at the CCHT Research Facility, Manning, Swinton, Szadkowski, Gusdorf, Ruest, February 14, 2005, http://irc.nrc-cnrc.gc.ca/pubs/rr/rr191/rr191.pdf
[5] Comprehensive Energy Use Database Tables, Residential Sector – Ontario, http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/trends_res_on.cfm?attr=0

Table 2 - Estimate of Proportion of NG Use for Space-Heating

Structural Type of Dwelling	Total Natural Gas Use (PJ)	Total Space-Heating Energy Use (PJ)	% of Space-Heating Energy Use That is NG*	Implied Space-Heating Natural Gas Use (PJ)	% of NG Use That is Space-Heating
Apartment	56	42	72%	30	53%
Single-Family Detached	252	272		196	78%

** Estimates are available only for all of Ontario and are not split by dwelling type.*

- The above table implies that a 6% reduction in total natural gas use in single-family homes is equivalent to a (6%/78%) = 7.74% reduction in space-heating natural gas use.
- Applying these savings to the multi-family sector (i.e., apartments), implies that for full set-back multi-family homes save (7.74%*53%) = 4.13% of total annual natural gas use.

Taking into account behavioural changes:

- Based on a recent Statistics Canada report[6], approximately 41% of Ontario households with non-programmable or non-programmed thermostats manually set back their thermostat at night (19% lowered by 3 or more degrees, 21% lowered by 1 or 2 degrees) in the winter season, whereas 59% did not lower their thermostat before going to sleep.
- Similar values were found based on an evaluation Ontario Power Authority's 2007 Hot and Cool Savings Program conservation program, a summary of which are presented in the table below.

Table 3 - Distribution of Behaviour 1

Behaviour		Sub-Behaviour, With Programmable T-Stat	
Practiced Manual Set-Back	40%	No additional set-back	73%
		3 or more degrees additional set-back	9%
		1 - 3 more degrees additional set-back	19%
Did Not Practice Manual Set-Back	50%	No additional set-back	44%
		3 or more degrees additional set-back	20%
		1 - 3 more degrees additional set-back	35%
Data Not Available (Refused to Answer)	10%	N/A	N/A
		N/A	N/A
		N/A	N/A

Note that in some cases values may add to more or less than 100% due to rounding error

- Navigant notes that the above distribution is very conservative. It is highly unlikely that those responding to the survey (either Navigant's or StatCan's) that practice manual thermostat set-back do so punctually every single evening of the year during the heating season. There are almost certainly incremental savings not captured in this sheet due to the automation of thermostat set-back amongst those that practice manual set-back. Lacking firm empirical data, however, these savings cannot accurately be estimated and are thus not included.
- The Hot and Cool Savings findings in the table above (excluding those that did not answer the survey questions) imply[7]:

[6] Statistics Canada, Household and Environment Survey, 2006

[7] For example: (40% Practiced Manual Set-Back*73% No Additional Set-Back + 50% Did Not Practice Manual Set-Back * 44% No Additional Set-Back)/(40% Practiced Manual Set-Back+50% Did Not Practice Manual Set-Back) = 57%

Table 4 - Distribution of Behaviour 2

Implied Overall Behaviour (Excluding Those That Refused to Answer)	Distribution of Households	Natural Gas Savings
No additional set-back	57%	0%
3 or more degrees additional set-back	15%	4.13%
1 - 3 more degrees additional set-back	28%	2.07%

- Average Ontario annual natural gas consumption by structural dwelling type may be estimated from NRCan data[8]:

Table 5 - Provincial Average NG Consumption

Structural Type of Dwelling	Total Housing Stock (thousands)	Total Natural Gas Use (PJ)	Natural Gas Use Per Household (m^3)*
Apartment	1400	56	1,046
Single-Family Detached	2774	252	2,379

** 1 GJ = 26.137 m^3 of NG*

- The average furnace natural gas consumption of a single family home in Enbridge's service territory is 2,291 m^3 and that of a water heater[9] is 550 m^3 for a total of 2,841 of m^3. This is somewhat higher than the average number reported by NRCan due to the fact that the NRCan number is an Ontario average and thus will include homes that use electricity for space and water heat. Scaling up the NRCan average annual natural gas consumption of apartments by the Enbridge single-family home/NRCan single-family home ratio (2,841/2,379 = 119%) implies that the average natural gas consumption for apartments in Enbridge's service territory is 1,249 m^3.
- Using the annual consumption derived above and the distribution derived in Table 4, above, Navigant estimates the following natural gas savings from the installation of programmable thermostats are:

  1,249 m^3 x [15%x4.13% + 28% x 2.07%)] = 15 m^3
- This represents an overall savings of 1.2% of total annual natural gas use (15 m^3 / 1,249 m^3 = 1.2%)

Annual Electricity Savings	**13 kWh**

<u>Heating Season Savings (Furnace fan)</u>

- The following is based on the CCHT study analysing furnace fan consumption in relation to set back temperatures from programmable thermostats[10], adjusted by the ratio of apartment space-heating natural gas use to single-family space-heating natural gas use (30%).

Temperature Set Back	Total Winter Furnace Electricity Consumption (kWh)	Seasonal Savings (%)
None (22C)	700	0%
18 C night time set back	694	0.8%
18 C daytime and night time set back	687	1.9%

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8 Comprehensive Energy Use Database Tables, Residential Sector – Ontario, http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/trends_res_on.cfm?attr=0

9 The average gas water heater consumption in Enbridge's service territory is 625 m^3 per year. According to EGD Load Research, 88% of EGD customers have a natural gas water heater, therefore the average annual consumption of gas for heating water in an EGD customer's home is 88%*625 m^3 = 550 m^3

Annual savings for full set-back night-time setback during the heating season are therefore 6 kWh.

- Applying the same behaviour changes as presented above in Table 4,furnace fan savings during the heating season are estimated to be as follows:

  6 kWh x (15% + 28%) = 2.58 kWh

Cooling Season Savings

- A side-by-side housing study conducted by the CCHT[10]. determined seasonal energy savings for a residential unit from a programmable thermostat as follows (the values below have been adjusted by the ratio of apartment space-heating natural gas use to single-family space-heating natural gas use, as above):

Temp Set Back	Total Summer Furnace and CAC Electricity Consumption (kWh)	Seasonal Savings (%)
None (22C)	938	0%
24 C daytime set back	837	11%
25 C daytime set back	719	23%

- A BC Hydro study[11] reports savings between 10% and 15% for 4°C set back during night and unoccupied periods, Energy Star Calculator[12] reports 6% saving per degree (Fahrenheit) for *cooling season*.
- Full-load cooling hours were estimated for Enbridge's service territory based on the findings of the Energy Center of Wisconsin[13]. The full-load cooling hours for Eau Claire and La Crosse were reported to be 293 and 361, respectively. These correspond to the average annual cooling degree days (CDD) in each location of 556 and 840, respectively. The average annual CDD for Ottawa and Toronto between 2000 and September 2010 were 570 and 718, respectively[14]. Using the relative CDD of Ottawa/Eau Claire and Toronto/La Crosse to factor the full-load cooling hours, the implied full-load cooling hours for Ottawa are 293 x (570/556) = 300 and for Toronto are 361 x (718/840) = 309. The average (304) of both cities' full-load cooling hours may be used as a reasonable proxy for the full-load cooling hours of Enbridge's service territory.
- Assuming that baseline multi-residential dwelling is equipped with a SEER 11[15], 1 ton[16] A/C unit and is used 304 hours per year[17], this implies that

  Base A/C electricity use = 304 (cooling hours)*[12,000 (Btu/hr)/(11 (SEER)* 1,000)] = 332 kWh

Taking into Account Changes in Behaviour (Cooling Season)

[10] The Effects of Thermostat Setting on Seasonal Energy Consumption at the CCHT Research Facility, Manning, Swinton, Szadkowski, Gusdorf, Ruest, February 14, 2005, http://irc.nrc-cnrc.gc.ca/pubs/rr/rr191/rr191.pdf

[11] Marbek Resource Consultants, TheSheltair Group Inc, BC Hydro BC Hydro Conservation Potential Review 2002, Residential Sector Support (Base Year: Fiscal 2000/01) (Revision 1) Submitted to: BC Hydro, June 2003

[12] US EPA (EPA Energy Star® Simple Savings Calculator – Programmable Thermostat), http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorProgrammableThermostat.xls

[13] Energy Center of Wisconsin, *Central Air Conditioning in Wisconsin: A Compilation of Recent Field Research*, May 2008

[14] Although typically in Canada CDD are calculated based on Celsius, for comparative purposes in this case CDD were calculated based on Fahrenheit, with 65° F used as the threshold temperature.

[15] NRCan's Comprehensive Energy Use Data-Base for Ontario (Residential, Table 27) indicates that the average stock SEER of an Ontario CAC unit is 10.7 for 2008 – no data exist for 2009 or 2010. Projecting historical SEER for stock out to 2010 using a linear trend estimated on the historical data beginning in 2001, Navigant estimates that current (2010) stock SEER is approximately 11 (11.05).

[16] Ontario Power Authority, 2009 OPA Measures and Assumptions Lists (Mass Market), November 2008, referenced from: Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI), 2006 Cool Savings Rebate Program, Prepared for the Ontario Power Authority, April 2007, adjusted to reflect the fact that, on average multi-residential dwellings are 46% the size of single-family dwellings upon which the OPA Measures and Assumptions are based.

[17] Number of full-load cooling hours provided by http://energyexperts.org/ac%5Fcalc/ and based on the assumption that Ontario's climate is sufficiently similar to that of the north-eastern U.S.

- Based on the same program evaluation survey for the OPA[18], found that following the installation of a programmable thermostat, respondents:

Thermostat set-back	Distribution
No thermostat set-back	64%
3 or more degrees set-back	13%
1 - 3 more degrees set-back	22%

- The OPA Hot and Cool Savings survey did not ask about customer behaviour previous to the installation of the programmable thermostat and thus the percent of customers that practiced manual set-back in the summer cannot be estimated from these survey results.
- Statistics Canada's report, *Households and the Environment* does not report the percent of the population that manually adjusts the thermostat when they are away from home during the summer. Navigant Consulting has therefore assumed that the distribution of behaviour changes (shown above) is identical for both the population which practice manual temperature changes and that which did not. This implies :

Thermostat set-back	Distribution of Households	Electricity Savings
No additional thermostat set-back	64%	0%
3 or more additional degrees set-back	13%	23%
1 - 3 additional degrees set-back	22%	11%

- NCI estimates the following cooling season electricity savings for each programmable thermostat installed in households with central air conditioning:

  332 kWh x (64% x 0% + 13% x23% +22% x 11%) = 18 kWh

- However, assuming a penetration rate of central air conditioners in Ontario = 57%[19], NCI estimates that the average home in Ontario will save the following in electricity during the cooling savings:

  57% x 18 kWh = 10 kWh

- Total electricity savings for both heating (furnace fan) and cooling savings for an average Ontario home are estimated to be kWh (3 kWh + 10 kWh = 13 kWh).

Annual Water Savings	**0 L**
N/A	

Other Input Assumptions

Effective Useful Life (EUL)	**15 Years**
Navigant Consulting is estimating 15 years as the effective useful life based on the average lifetime of programmable thermostat from Energy Star ® website.	
Base & Incremental Conservation Measure Equipment and O&M Costs	**$80**
Enbridge, in consultation with trade allies has estimated the installation cost of this retrofit measure to be $40 (to be paid by Enbridge mail-in rebate) and estimated the equipment cost to be $40 following a review of retail outlets such as Home Depot by Enbridge Program Manager.	

[18] Navigant Consulting, Evaluation Report: 2007 Hot and Cool Savings Programs, prepared for the Ontario Power Authority (OPA), July 2008.
[19] Natural Resource Canada, Survey of Household Energy Use (SHEU), December 2005

ROOFTOP UNIT

Commercial New & Existing

Efficient Technology & Equipment Description
Two-stage rooftop unit, up to and including 5 tons of cooling (85% efficient)
Base Technology & Equipment Description
Single-stage rooftop unit (80% efficient)

Resource Savings Assumptions

Natural Gas	**255**	**m^3**
As approved by EB – 2008-0346, Gas-fired Rooftop Unit, Decision Type: New. The incremental cost associated with these this measure does not vary according to the type of installation being either new or retrofit. This is due to the fact that the incremental cost associated with each measure is related to the unit itself. Incremental cost is not related to the installation of the unit nor is it related to a combination of the unit itself and the installation. For example, when replacing a rooftop unit with a high efficiency rooftop unit, the only factor affecting the decision is the incremental cost of the unit itself since the infrastructure to support the operation of the rooftop unit is already in place in the building. It is merely a matter of removing an old unit and replacing it with a new unit. The same applies to new construction.		
Electricity	**n/a**	**kWh**
Water	**n/a**	**L**

Other Input Assumptions

Equipment Life	**15**	**years**
As approved by EB – 2008-0346, Gas-fired Rooftop Unit, Decision Type: New. Equipment life is not dependent on Decision Type.		
Incremental Cost (Cust. / Contr. Install)	**$375**	
As approved by EB – 2008-0346, Gas-fired Rooftop Unit, Decision Type: New. The incremental cost is based on the difference between a new single stage unit and a new two stage unit and is therefore not dependent on Decision Type.		
Free Ridership	**5**	**%**
Free-ridership rate as per EB-2008-034 and 0385		

Commercial Water Heating

OZONE LAUNDRY

Commercial – New/Existing

Efficient Technology & Equipment Description
Commercial Laundry Washing Equipment with Ozone In the commercial laundry industry, ozone is generated via corona discharge or ultraviolet light. It dissolves in cold to ambient temperature water (light and medium soil laundry) and activates the detergents, improving their activity and leading to a stronger cleaning action. However, since the solubility of ozone is low and its decomposition is faster at higher temperatures (38degC, (100degF)), the use of ozone is not recommended for heavy soils, which require warmer water. Generally, heavy soil laundry is treated with traditional laundry techniques.
Qualifier/Restriction
- No residential style clothes washers - Minimum required annual laundry load for each washer using ozone is: Washer Type — Minimum Laundry Load (Lbs/yr) Washer extractor – 60 lbs — 100,000 lbs/yr Washer extractor – 500 lbs — 260,000 lbs/yr Tunnel Washer – 120 lbs — 600,000 lbs/yr Tunnel Washer – 500 lbs — 1,900,000 lbs/yr
Base Technology & Equipment Description
Commercial Laundry Washing Equipment without Ozone

Resource Savings Assumptions

Natural Gas		**See below**
Washer Type	Gas Savings per Pounds washed per year (Lbs/yr)	
Washer extractor – 60 lbs	**0.0328**	**m3/(lbs/yr)**
Washer extractor – 500 lbs	**0.0328**	**m3/(lbs/yr)**
Tunnel Washer – 120 lbs	**0.0240**	**m3/(lbs/yr)**
Tunnel Washer – 500 lbs	**0.0240**	**m3/(lbs/yr)**

Operating conditions used to calculate the energy consumptions per pound of laundry evaluated using input data from the “Ozone Company” and from a linen service: “La Buanderie Centrale de Montréal”. These operating conditions are typical of what may be found in high production industrial laundries[1]. Assumptions: supply water temperature of 9 degC and natural gas water heater efficiency of 78%. Note that 120 lbs is a typical tunnel washer capacity. Larger tunnel washers (up to 500 lbs) do exist but are less frequent.

The savings was normalized by dividing the estimated savings by the annual laundry load (lbs/yr) of laundry found in the report.

[1] Riesenberg, James, “PBMP- Commercial Laundry Facilities”, Koeller and Company, November 4th, 2005

Electricity	**See below**
Electrical savings were based on the same conditions as described above.	

Washer Type	Electricity savings per Pounds washed per year (Lbs/yr)	
Washer extractor – 60 lbs	**0.00219**	**kWh/(lbs/yr)**
Washer extractor – 500 lbs	**0.00219**	**kWh/(lbs/yr)**
Tunnel Washer – 120 lbs	**0.00152**	**kWh/(lbs/yr)**
Tunnel Washer – 500 lbs	**0.00152**	**kWh/(lbs/yr)**

Water	**See below**
Electrical savings were based on the same conditions as described above.	

Washer Type	Water savings	
Washer extractor – 60 lbs	**2.01**	**L/(lbs/yr)**
Washer extractor – 500 lbs	**2.01**	**L/(lbs/yr)**
Tunnel Washer – 120 lbs	**1.22**	**L/(lbs/yr)**
Tunnel Washer – 500 lbs	**1.22**	**L/(lbs/yr)**

Other Input Assumptions

Equipment Life	**15 yrs**
Savings attributed to the measures are expected to last the life expectancy of the equipment. This data was obtained from suppliers.[2]	

Incremental Cost	**See below**
Washer Type	Incremental Costs
Washer extractor – 60 lbs	**$10,970**
Washer extractor – 500 lbs	**$30,270**
Tunnel Washer – 120 lbs	**$49,667**
Tunnel Washer – 500 lbs	**$160,065**

Capital and installation costs were obtained in US dollars from The Ozone Company and converted to Canadian dollars.[3],[4]

Free Ridership	**8 %**
Free Ridership was estimated using market penetration in UG territory, according to the results of a survey conducted by TNS Canadian Facts. Further penetration of ozone systems for laundry is presently limited by the type of washing machines used (ozone cannot be used with residential type commercial machines)[5].	

[63] Riesenberg, James, "PBMP- Commercial Laundry Facilities", Koeller and Company, November 4th, 2005
[64] NGTC, DSM OZONE LAUNDRY TREATMENT Final Report_v02 (#134809) November 25, 2009, Pgs iv-vi
[65] NGTC, DSM OZONE LAUNDRY TREATMENT Final Report_v02 (#134809) November 25, 2009, Pg 6
[66] NGTC, DSM OZONE LAUNDRY TREATMENT Final Report_v02 (#134809) November 25, 2009, Pgs iv-vi

[2] NGTC, DSM OZONE LAUNDRY TREATMENT Final Report_v02 (#134809) November 25, 2009, Pgs iv-vi
[3] NGTC, DSM OZONE LAUNDRY TREATMENT Final Report_v02 (#134809) November 25, 2009, Pg 6
[4] NGTC, DSM OZONE LAUNDRY TREATMENT Final Report_v02 (#134809) November 25, 2009, Pgs iv-vi
[5] NGTC, DSM OZONE LAUNDRY TREATMENT Final Report_v02 (#134809) November 25, 2009, Pgs 19

[67] NGTC, DSM OZONE LAUNDRY TREATMENT Final Report_v02 (#134809) November 25, 2009, Pgs 19

CONDENSING BOILERS UNDER 300 MBH

Small Commercial – New/Existing

Efficient Technology & Equipment Description
Condensing boilers having annual fuel utilization efficiency (AFUE) of 90% or greater. Boiler input size is under 300,000 Btu/hr. Application is for seasonal or non-seasonal use. MBH is defined throughout this document as 1,000 Btu/hr.
Base Technology & Equipment Description
Non-condensing boiler having an AFUE of 80% for either seasonal or non-seasonal use. Boiler input size is under 300,000 Btu/hr.

Resource Savings Assumptions

Natural Gas	**<u>Seasonal</u>** **0.0108 m^3 /(Btu/hr Boiler Input)** **<u>Non-Seasonal</u>** **Boiler Input Under 100 MBH = 0.03579 m^3 /(Btu/hr Boiler Input)** **Boiler Input 100 To Under 200 MBH = 0.02196 m^3 /(Btu/hr)** **Boiler Input 200 To Under 300 MBH = 0.01643 m^3 /(Btu/hr)**

<u>Estimation Based on Agviro Study for Enbridge</u>

- Based on Agviro's report[1], the energy analysis compares use of a condensing boiler having an AFUE of 93% versus a base case non-condensing boiler having an AFUE of 80%.
- The normalized gas use for a seasonal base case boiler is determined by the relationship:

$$Normalized\ GasUse = 77.575 \times BoilerIP$$

where:

BoilerIP = seasonal boiler input size (MBH)
Normalized Gas Use = normalized annual seasonal gas use (m3/yr)

- The gas savings for a non-seasonal base case boiler is determined by the relationship:

$$NonSeasonal\ GasUse = 36.282 \times BoilerIP + 9256.9$$

where:

BoilerIP = seasonal boiler input size (MBH)
Non Seasonal Gas Use = annual non-seasonal gas use (m3/yr)

- The gas savings of the condensing versus the base case boiler is determined by the relationship:

$$GasSavings = GasUse \times (1 - \frac{\%Eff_{BC}}{\%Eff_{CE}})$$

[1] Prescriptive Savings Analysis – Condensing Boilers Under 300MBH, Agviro Inc., Jan 17, 2011

where:

GasUse = seasonal or non-seasonal gas use (m3)
$\%Eff_{BC}$ = Efficiency of the Base Case boiler
[seasonal = 80%; non-seasonal=66.2%]
$\%Eff_{CE}$ = Efficiency of the Condensing boiler
[seasonal = 93%; non-seasonal=85.32%]
GasSavings = annual gas savings (m3/yr)

- On a per Btu/hr boiler input basis, the natural gas savings is:
  - seasonal boiler = 0.0108 m^3 / (Btu/hr)
  - non-seasonal boiler =
    - Boiler Input Under 100 MBH = 0.03579 m^3 /(Btu/hr Boiler Input)
    - Boiler Input 100 To Under 200 MBH = 0.02196 m^3 /(Btu/hr)
    - Boiler Input 200 To Under 300 MBH = 0.01643 m^3 /(Btu/hr)

Electricity	**0 kWh**

Water	**0 L**

Other Input Assumptions

Equipment Life	**25 yrs**

-

Incremental Cost	**<u>Existing Construction</u>**	
	Boiler Input (MBH)	**Incremental Cost ($)**
	Under 100	**$2,045**
	100 To Under 200	**$2,984**
	200 To Under 300	**$3,797**
	<u>New Construction</u>	
	Boiler Input (MBH)	**Incremental Cost ($)**
	Under 100	**$1,475**
	100 To Under 200	**$2,414**
	200 To Under 300	**$3,227**

Incremental costs account for differences in venting, controls and labour.

<u>Incremental Cost – Existing Construction</u>

- Boiler Input Under 100 MBH = $2,045
- Boiler Input 100 To Under 200 MBH = $2,984
- Boiler Input 200 To Under 300 MBH = $3,797

Incremental Cost – New Construction

- Boiler Input Under 100 MBH = $1,475
- Boiler Input 100 To Under 200 MBH = $2,414
- Boiler Input 200 To Under 300 MBH = $3,227

Condensing Gas Water Heater - Commercial

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description

Condensing Gas Water Heater[1] (95% thermal efficiency), 50 gallons.

Due to the variability in energy savings for commercial buildings resulting from the quantity of daily water use, resource savings were calculated for three scenarios of daily hot water use[2]:

Scenario **A**: 100 gallons (378 litres)
Scenario **B**: 500 gallons (1,893 litres)
Scenario **C**: 1,000 gallons (3,786 litres)

Base Equipment and Technologies Description

Conventional storage tank gas water heater[3] (thermal efficiency[4]=80%), 91 gallons.

Decision Type	Target Market(s)	End Use
New/Retrofit	Commercial (New/Existing)	Water heating

Codes, Standards, and Regulations

Ontario's Energy Efficiency Act[5] applies only to water heaters with an input rating of less than 75,000 Btu/hr.

[1] Locally available commercial condensing gas water heater, trade name: Polaris, model #: PC 199-50 http://www.johnwoodwaterheaters.com/pdfs/GSW_PolarisSpecSheet.pdf
[2] One of the input assumptions required for calculating resource savings for this measure is the stand-by heat loss of storage tank water heaters. Hourly stand-by losses are treated as constant using values drawn from GAMA's *Consumer Directory* (see citation below). This means that marginal percentage gas savings will fall as hot water use rises.
[3] Locally available commercial conventional (non-condensing) gas water heater with the same input rating as the Polaris. Manufacturer: Rheem, model #: G91-200.
[4] Although the required minimum thermal efficiency to be in compliance with ASHRAE 90.1 is 78%, http://www.energycodes.gov/comcheck/pdfs/404text.pdf, only an very small percentage of commercial gas water heaters listed in the GAMA *Consumer's Directory of Certified Efficiency Ratings* had a thermal efficiency of less than 80%. http://www.neo.ne.gov/neq_online/july2006/commgaswtrhtr.pdf
[5] http://www.energy.gov.on.ca/english/pdf/conservation/2006%20-%20EEA%20Guide%20C%20-%20Water%20Heaters.pdf

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	**A**: 332 **B**: 873 **C**: 1,551	0	0	5,880	3,650
2	**A**: 332 **B**: 873 **C**: 1,551	0	0	0	0
3	**A**: 332 **B**: 873 **C**: 1,551	0	0	0	0
4	**A**: 332 **B**: 873 **C**: 1,551	0	0	0	0
5	**A**: 332 **B**: 873 **C**: 1,551	0	0	0	0
6	**A**: 332 **B**: 873 **C**: 1,551	0	0	0	0
7	**A**: 332 **B**: 873 **C**: 1,551	0	0	0	0
8	**A**: 332 **B**: 873 **C**: 1,551	0	0	0	0
9	**A**: 332 **B**: 873 **C**: 1,551	0	0	0	0
10	**A**: 332 **B**: 873 **C**: 1,551	0	0	0	0
11	**A**: 332 **B**: 873 **C**: 1,551	0	0	0	0
12	**A**: 332 **B**: 873 **C**: 1,551	0	0	0	0
13	**A**: 332 **B**: 873 **C**: 1,551	0	0	0	0
TOTALS	**A**: 4,316 **B**: 11,349 **C**: 20,163	**0**	**0**	**5,880**	**3,650**

Resource Savings Assumptions

Annual Natural Gas Savings	A: 332 m^3 B: 873 m^3 C: 1,551 m^3

Assumptions and inputs:

- Daily hot water draw:

Scenario A: 100 gallons (378 litres)
Scenario B: 500 gallons (1,893 litres)
Scenario C: 1,000 gallons (3,786 litres)

- Input rating for efficient and base equipment: 199,000 Btu.
- Average water inlet temperature: 9.33 ^{o}C (48.8 ^{o}F)[6]
- Average water heater set point temperature: 54 ^{o}C (130 ^{o}F)[7]
- Stand-by loss of (condensing) Polaris PC 199-50 3NV: 244 Btu/hr[8].
- Stand-by loss of (non-condensing) Rheem G91-200: 1,050 Btu/hr[9].

Annual gas savings calculated as follows:

$$Savings = \left[W * 8.33 * (T_{out} - T_{in}) * \left(\frac{1}{Eff_{base}} - \frac{1}{Eff_{eff}} \right) + \left(Stby_{base} - Stby_{eff} \right) * 24 * 365 \right] * 10^{-6} * 27.8$$

Where:

W = Annual hot water use (gallons)
8.33 = Energy content of water (Btu/gallon/^{o}F)
T_{out} = Water heater set point temperature (^{o}F)
T_{in} = Water inlet temperature (^{o}F)
Eff_{base} = Thermal efficiency of base equipment
Eff_{eff} = Thermal efficiency of efficient equipment
10^{-6} = Factor to convert Btu to MMBtu
$Stby_{base}$ = Stand-by loss per hour for base equipment (Btu)
$Stby_{eff}$ = Stand-by loss per hour for efficient equipment (Btu)
24 = Hours per day
365 = Days per year
27.8 = Factor to convert MMBtu to m^3

Scenario A: Gas savings were determined to be 29% over base measure
Scenario B: Gas savings were determined to be 19% over base measure
Scenario C: Gas savings were determined to be 17% over base measure

$$PercentSavings = \frac{\left(G_{base} - G_{eff} \right)}{G_{base}}$$

G_{eff} = Annual natural gas use with efficient equipment,
Scenario **A:** 782 m^3

[6] Chinnery, Glen. *Policy Recommendations for the HERS Community to Consider regarding HERS point credit for Waste Water Heat Recovery Devices,*EPA, Energy Star for homes, March 2004 http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/Waste_Water_Heat_Recovery_Guidelines.pdf
[7] As suggested by NRCan: http://oee.nrcan.gc.ca/residential/personal/new-homes/water-conservation.cfm?attr=4
[8] *Consumer's Directory of Certified Efficiency Ratings* http://www.neo.ne.gov/neq_online/july2006/commgaswtrhtr.pdf In this case stand-by losses are constant. Recalculating gas savings using the WHAM algorithm, in which stand-by losses are a function of water draw, results in less than 3% variation over the figures presented above. Lutz, J.D., C.D. Whitehead, A.B. Lekov, G.J. Rosenquist., and D.W. Winiarski. 1999. *WHAM: Simplified tool for calculating water heater energy use*. ASHRAE Transactions 105 (1): 1005-1015.
[9] *Consumer's Directory of Certified Efficiency Ratings*http://www.neo.ne.gov/neq_online/july2006/commgaswtrhtr.pdf.

Scenario **B:** 3,672 m^3 Scenario **C:** 7,284 m^3 G_{base} = Annual natural gas use with base equipment, Scenario **A:** 1,114 m^3 Scenario **B:** 4,545 m^3 Scenario **C:** 8,835 m^3	
Annual Electricity Savings	**0 kWh**
N/A	
Annual Water Savings	**0 L**
Navigant has assumed that adopting the measure would not affect the quantity of water consumed.	

Other Input Assumptions

Effective Useful Life (EUL)	**13 Years**
Studies conducted in two different jurisdictions (Iowa[10] and Washington State[11]) use an EUL of 13 years, whereas one conducted for Enbridge and Union in 2000[12] uses an EUL of 15 years. Given that the two most recent studies both use 13 years, Navigant Consulting also recommends adopting 13 years.	
Base & Incremental Conservation Measure Equipment and O&M Costs	**2,230 $**
Incremental cost determined from communication with local distributor[13]	
Customer Payback Period (Natural Gas Only)[14]	**A: 13 Years** **B: 5 Years** **C: 2.8 Years**
Using a 5-year average commodity cost (avoided cost)[15] of \$0.38 / m^3 and an average commercial distribution cost[16] of \$0.12 / m^3, the payback period for natural gas savings is determined to be 13 years for Scenario A, 5 years for Scenario B and 2.8 years for Scenario C, based on the following: Payback Period = Incremental cost / (natural gas savings x natural gas cost) Scenario A = \$2,230/ (332 m^3/year * \$0.5 / m^3) = 13 years Scenario B = \$2,230/ (873 m^3/year * \$0.5 / m^3) = 5 years Scenario C = \$2,230/ (1,614 m^3/year * \$0.5 / m^3) = 2.8 years	
Market Penetration[17]	**Low**
Based on the observation of low penetration in another jurisdiction (Washington State[18] – 5%), the paucity of distributors in Ontario and of the relatively high incremental cost, Navigant Consulting estimates the penetration in Ontario to be low.	

[10] Iowa Utilities Board. Docket No. EEP-08-02 MidAmerican Energy Company. Volume IV, Appendix D, Part 1 of 2
[11] Quantec *Comprehensive Assessment of Demand-Side Resource Potentials (2008-2027)* Prepared for Puget Sound Energy
[12] Jacques Whitford Environment Ltd, *Prescriptive Incentives for Select Natural Gas Technologies*, Sept 2000
[13] Rheem G91-200: \$3,650
Polaris PC 199-50: \$5,880
[14] Customer payback period has been calculated using natural gas savings only. Where applicable, payback period is expected to decrease when electricity and/or water savings are included.
[15] 2009 Avoided gas cost provided by Union Gas. 5 year average avoided gas cost determined by taking average for baseload and weather sensitive avoided gas cost.
[16] Average distribution cost taken calculated from both Union Gas website (http://www.uniongas.com/residential/rates/) and Enbridge Gas websites (https://portal-plumprod.cgc.enbridge.com/portal/server.pt?open=512&objID=248&PageID=0&cached=true&mode=2&userID=2).
[17] Navigant Consulting is defining “Low” as below 5%, “Medium” as between 5-50%, and “High” as above 50%,
[18] Quantec *Comprehensive Assessment of Demand-Side Resource Potentials (2008-2027)* Prepared for Puget Sound Energy

Measure Assumptions Used by Other Jurisdictions

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
Pacific Gas & Electric, April 2007[19]	2,107	N/A	N/A	N/A

Comments
Average daily hot water use 2,083 gallons per day, thermal efficiency of new technology (60 gallon tank), 95%, thermal efficiency of base measure (standard efficiency tankless water heater), 82%. Measure provides savings of 28% over 7,496 m^3 required for heating water used with base equipment.

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
Puget Sound Energy, 2007[20]	0.78 per ft^2.	13	N/A	5%

Comments
Savings calculated for an existing restaurant. Measure saves 34% of 2.28 m^3 per square foot required for water heating.

[19] Karras, A. and D. Fisher, *Energy Efficiency Potential of Gas-Fired Water Heating Systems in a Quick Service Restaurant.* Pacific Gas & Electric, April 2007 http://www.fishnick.com/publications/appliancereports/special/Commercial_Water_Heating_Systems.pdf

[20] Quantec *Comprehensive Assessment of Demand-Side Resource Potentials (2008-2027)* Prepared for Puget Sound Energy

Drain Water Heat Recovery (DWHR) Units – Laundromat

New Construction

Description/Comment
Laundry - with storage tank and pumping equipment. Savings and Costs are Shown per Laundromat.

Efficient Equipment and Technologies Description
Drain Water Heat Recovery (DWHR) pre-heats incoming domestic cold water with the available drain water heat that would otherwise be lost. A storage tank and pumping equipment is needed for batch-style (i.e., front load or top load) Laundry equipment to ensure cold water flows into the DWHR system and warm drain water flows out concurrently.
Base Equipment and Technologies Description
None

Decision Type	Target Market	End Use
New Construction.	Laundromats. Laundry Equipment.	Water Heating

Codes, Standards and Regulations

None.

Resource Savings Table

	Electricity and other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (KWh)	Water (L)	($)	($)
1	49,735	0	0	$31,820.00	$0.00
2	49,735	0	0	$545.45	$0.00
3	49,735	0	0	$495.87	$0.00
4	49,735	0	0	$450.79	$0.00
5	49,735	0	0	$409.81	$0.00
6	49,735	0	0	$372.55	$0.00
7	49,735	0	0	$338.68	$0.00
8	49,735	0	0	$307.89	$0.00
9	49,735	0	0	$279.90	$0.00
10	49,735	0	0	$254.46	$0.00
11	49,735	0	0	$231.33	$0.00
12	49,735	0	0	$210.30	$0.00
13	49,735	0	0	$191.18	$0.00
14	49,735	0	0	$173.80	$0.00

15	49,735	0	0	$158.00	$0.00
16	49,735	0	0	$143.64	$0.00
17	49,735	0	0	$130.58	$0.00
18	49,735	0	0	$118.71	$0.00
19	49,735	0	0	$107.92	$0.00
20	49,735	0	0	$98.10	$0.00
21	49,735	0	0	$89.19	$0.00
22	49,735	0	0	$81.08	$0.00
23	49,735	0	0	$73.71	$0.00
24	49,735	0	0	$67.01	$0.00
25	49,735	0	0	$60.92	$0.00
Total	**1,243,364**	**0**	**0**	**$37,211**	**$0.00**

Resource Savings Assumptions

Annual Natural Gas Savings	**49,735**	m^3

One manifolded DWHR assembly (made of (4) units or pipes) is connected, with storage and pumping equipment to the laundry equipment.

The following are the characteristics used to estimate the drain water from the laundry equipment:
Laundry Rate: 0.37 Loads/person/day [1]
Water Usage Rate: 60 L/load[2]
Consumer base for Laundromat: 1303 [3][4][5] Based on the number of Laundromats in the service area and the number of persons who use Laundromats.

$$Yearly\ Concurrent\ Drainwater\ Flow = 0.37\ (Loads/person/day) \times 60\ (L/load) \times 1303\ (persons) \times 365\ (days) = 10{,}536{,}258\ (L/year)$$

The energy that can be recovered and therefore natural gas saved is calculated based on the following factors:
Yearly concurrent drain water flow: see above calculation
Drain water temperature for laundry equipment: 70°C [6]
Domestic Cold Water Temperature: 9.33 °C [7]
DWHR unit effectiveness for noted piping configuration: 60% [8]
Storage losses derating factor: 90% [9]
Standard Natural gas water heater efficiency: 78%

$$Natural\ Gas\ Saving\ (m^3) = \frac{10{,}536{,}258\ \left(\frac{L}{year}\right) \times 4.184\ \left(\frac{KJ}{Kg\ °C}\right) \times [70\ (°C) - 9.33\ (°C)] \times 60\ (\%) \times 90\ (\%)}{78\ (\%) \times 37230\ \left(\frac{KJ}{m^3}\right)}$$

$$= 49{,}735\ (m^3/year)$$

Annual Electricity Savings	**0**	KWh

N/A

Annual Water Savings	**0**	L

N/A

Other Input Assumptions

Effective Useful Life (EUL)	**25**	Years
The DWHR units have a useful life in excess of 25 years. [8]		
Base & Incremental Conservation Measure Equipment and O&M Cost	**37,211**	$
DWHR assembly cost: $12,920.[10] One assembly made up of (4) units (pipes) is required in this case.. Accessories cost: $13,500. Includes costs for pumps, storage tank, controls and other necessary equipment for non-concurrent flow applications. Installation: $4,800. This is calculated based on the materials, equipment and labour needed to install a unit, as estimated from RS Means. Maintenance: $600. DWHR is a passive technology and requires no maintenance similar to the piping systems that it is connected to. However, the storage tank and pump will require yearly maintenance and the pump requires some energy to operate.[11] A discount rate of 10%, consistent with the TRC calculation, is applied to the yearly O&M cost, to calculate the NPV ($5991). $37,211 = $12,920 + $13,500 + $4,800 + $5991		
Number of DWHR Units for Reported Savings	**4**	Units
One manifolded DWHR assembly is required to handle the high flow rates for the laundry equipment. There are 4 DWHR units per assembly. The savings and payback are based on this configuration, which is representative of an average laundromat.		
Customer Payback Period (Natural Gas Only)	**2.2**	Years
Simple payback period, based on a natural gas price of $0.30/m^3$.		

$$Simple\ Payback\ Period\ = \frac{Incremental\ Cost}{Natural\ Gas\ Savings\ \times\ Natural\ Gas\ Cost - Yearly\ Cost}$$

$$= \frac{31{,}220(\$)}{49{,}735(m^3) \times 0.3\ (\$/m^3) -\ 600\ (\$)} = 2.2\ (years)$$

References

[1] Gleick, P.H., et al. Waste Not, Want Not: The Potential for Urban Water Conservation in California. Pacific Institute: Oakland, California, 2003.

[2] Speed Queen, Front Load Washer Horizon Line Product Brochure, 2010. Available at www.speedqueen.com

[3] Buertime, Industry Overview- Coin Operated Laundry, 2010. Available at http://buyertime.com/Laundry.html

[4] Coin Laundry Association, Industry Overview, 2006. Available at http://coinlaundry.org/resources/industryoverview.cfm

[5] Statistics Canada, Study: Changes and Challenges for Canada's Residential Real Estate Landlords, The Daily, May 25 2007. Available at http://www.statcan.gc.ca/daily-quotidien/070525/dq070525b-eng.htm

[6] ASHRAE Handbook 2007, HVAC Applications, Section 49 - Service Water Heating

[7] Cited in the following as personal communication with City of Toronto Works Dept. VEIC, Comments on Navigant's Draft Gas Measure Characterizations, March 2009.

[8] RenewABILITY Energy Inc., RenewABILITY Inc. Product Presentation, Delivered at Enermodal Engineering on November 2, 2009

[9] Value is from common industry practice, communication with Enermodal Engineering, November 2010.

[10] RenewABILITY Energy Inc.

[11] Enermodal Engineering, Development of DSM Measures and Market Information on Commercial Drain Water Heat Recovery, Rev 1., March 31, 2010

Drain Water Heat Recovery (DWHR) Units – Arena, Showering

New Construction

Description/Comment
Showering. Savings and Costs are shown per Showerhead.

Efficient Equipment and Technologies Description
Drain Water Heat Recovery (DWHR) pre-heats incoming domestic cold water with the available drain water heat that would otherwise be lost.
Base Equipment and Technologies Description
None

Decision Type	Target Market	End Use
New Construction.	Recreation Facility/ Arena. Showering.	Water Heating

Codes, Standards and Regulations

None.

Resource Savings Table

	Electricity and other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3 /showerhead)	Electricity (KWh /showerhead)	Water (L /showerhead)	($/showerhead)	($/showerhead)
1	394	0	0	$776	$0.00
2	394	0	0	$0.00	$0.00
3	394	0	0	$0.00	$0.00
4	394	0	0	$0.00	$0.00
5	394	0	0	$0.00	$0.00
6	394	0	0	$0.00	$0.00
7	394	0	0	$0.00	$0.00
8	394	0	0	$0.00	$0.00
9	394	0	0	$0.00	$0.00
10	394	0	0	$0.00	$0.00
11	394	0	0	$0.00	$0.00
12	394	0	0	$0.00	$0.00
13	394	0	0	$0.00	$0.00
14	394	0	0	$0.00	$0.00

15	394	0	0	$0.00	$0.00
16	394	0	0	$0.00	$0.00
17	394	0	0	$0.00	$0.00
18	394	0	0	$0.00	$0.00
19	394	0	0	$0.00	$0.00
20	394	0	0	$0.00	$0.00
21	394	0	0	$0.00	$0.00
22	394	0	0	$0.00	$0.00
23	394	0	0	$0.00	$0.00
24	394	0	0	$0.00	$0.00
25	394	0	0	$0.00	$0.00
Total	**9,855**	**0**	**0**	**$776**	**$0.00**

Resource Savings Assumptions

Annual Natural Gas Savings	**394**	m^3/showerhead

The savings associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of showerheads, resulting in savings per showerhead. This will allow for different system sizes. See below for details.

One DWHR assembly (with 2 pipes) is connected to the showers in the change rooms of the facility.

The following are the characteristics used to estimate the drain water from showers :
Showerhead flow rate: 4.7 L/min (1.25 GPM) [1]
Shower Usage Rate: 10% [2] Amount of time shower is in use.
Facility Hours of Operation: 16 hours per day [3]
Showers per Facility: 12 showers/facility [4]

$$Yearly\ Concurrent\ Drainwater\ Flow$$

$$= 4.7\ (L/min) \times 16\ (hours/day) \times 60\ (min/hour) \times 365\ (days/year) \times 10\% \times 12\ (showers/facility)$$

$$= 1{,}976{,}256\ (L/year)$$

The energy that can be recovered and therefore natural gas saved is calculated based on the following factors:
Yearly concurrent drain water flow: see above calculation
Drain water temperature for showers: 37°C [5]
Domestic Cold Water Temperature: 9.33 °C [6]
DWHR unit effectiveness for noted piping configuration: 60% [7]
Standard Natural gas water heater efficiency: 78%

$$Natural\ Gas\ Saving\ (m^3) = \frac{1{,}976{,}256\ (L/year/facility) \times 4.187\ (KJ/(Kg\,°C)) \times [37\ (°\ C) - 9.33\ (°\ C)] \times 60\ (\%)}{78\ (\%) \times 37230\ (KJ/m^3)}$$

$$= 4{,}731 (m^3/year)$$

394 m3/yr per showerhead = 4731 m3/yr / 12 showers per facility

Annual Electricity Savings	0	KWh/showerhead
N/A		
Annual Water Savings	**0**	**L/showerhead**
N/A		

Other Input Assumptions

Effective Useful Life (EUL)	25	Years
The DWHR units have a useful life in excess of 25 years. [7]		
Base & Incremental Conservation Measure Equipment and O&M Cost	**776**	**$/showerhead**
The cost associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of showerheads, resulting in costs per showerhead. DWHR assembly cost: $5,510. One assembly with 2 DWHR units (pipes) is required in this case.[8][9][10] Installation: $3,800 (total). This is calculated based on the materials, equipment and labour needed to install a unit, as estimated from RS Means $9,310 = $3,800 + $5,510 $776 per showerhead = $9,310/12 showerheads per facility. Maintenance: $0. DWHR is a passive technology and requires no maintenance similar to the piping systems that it is connected to.		
Customer Payback Period (Natural Gas Only)	**6.6**	**Years**
Simple payback period, based on a natural gas price of $0.30/m^3.		

$$Simple\ Payback\ Period = \frac{Incremental\ Cost}{Natural\ Gas\ Savings \times Natural\ Gas\ Cost}$$

$$= \frac{776(\$)}{394\ (m^3) \times 0.3\ (\$/m^3)} = 6.6\ (years)$$

References

[1] 1.25 GPM showerheads were used based on the likelihood of the facility participating in the low-flow showerhead program. This was agreed to by UG and their Evaluation and Audit Committee in November-December 2010.

[2] Ontario Recreation Facility Association (ORFA) indicated half of the showers are "on" 10-15 minutes/hr on average. This value will be higher for weekends and primetime periods. 10% = 12.5 minutes "on" / 60 minutes * 50% of showers

[3] Based on survey of typical rinks by Enermodal, corroborated with a web search of five rinks by UG.

[4] The typical maximum number of showers that can be ganged is 12. This is based on Enermodal's discussions with DWHR suppliers.

[5] ASHRAE Handbook 2007, HVAC Applications, Section 49 - Service Water Heating

[6] Cited in the following as personal communication with City of Toronto Works Dept. VEIC, Comments on Navigant's Draft Gas Measure Characterizations, March 2009.

[7] RenewABILITY Energy Inc., RenewABILITY Inc. Product Presentation, Delivered at Enermodal Engineering on November 2, 2009

[8] The number of assemblies required is based on the supplier RenewABILITY Energy Inc. and modified to account for the installation of low flow showerheads (1.25 GPM) instead of typical showerheads in agreement with the research contractor, Enermodal. Low flow showerheads are expected to be half the flow rate of typical showerheads.

[9] Enermodal Engineering, Development of DSM Measures and Market Information on Commercial Drain Water Heat Recovery, Rev 1., March 31, 2010

[10] The original report from Enermodal required two assemblies to service 12 typical flow showerheads. However, after the report, the showerhead flow rates were reduced by 50% (to 1.25 GPM). DWHR systems are sized according to flow rate, so if the flow rate is half of the original, the number of DWHR assemblies required will be half as well. Enermodal agreed to reduce the number of DWHR assemblies from two to one, which reduces the cost of the equipment by 50%.

Drain Water Heat Recovery (DWHR) Units – University/College Cafeterias, Dishwashing

New Construction

Description/Comment
Continuous Flow Dishwasher. Savings and Costs are shown per Meal Served per Day.

Efficient Equipment and Technologies Description
Drain Water Heat Recovery (DWHR) pre-heats incoming domestic cold water with the available drain water heat that would otherwise be lost. This measure applies only to DWHR systems installed with Continuous Flow Dishwashers where there is concurrent hot water flow in and drain water flow out of the DWHR system.
Base Equipment and Technologies Description
None

Decision Type	Target Market	End Use
New Construction.	University/College Cafeterias. Kitchen Dishwashing. Continuous Flow Dishwashers	Water Heating

Codes, Standards and Regulations

None.

Resource Savings Table

	Electricity and other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3/Meal per Day)	Electricity (KWh/Meal per Day)	Water (L/Meal per Day)	($/Meal per Day)	($/Meal per Day)
1	4.6	0	0	$3.41	$0.00
2	4.6	0	0	$0.00	$0.00
3	4.6	0	0	$0.00	$0.00
4	4.6	0	0	$0.00	$0.00
5	4.6	0	0	$0.00	$0.00
6	4.6	0	0	$0.00	$0.00
7	4.6	0	0	$0.00	$0.00
8	4.6	0	0	$0.00	$0.00
9	4.6	0	0	$0.00	$0.00
10	4.6	0	0	$0.00	$0.00
11	4.6	0	0	$0.00	$0.00

12	4.6	0	0	$0.00	$0.00
13	4.6	0	0	$0.00	$0.00
14	4.6	0	0	$0.00	$0.00
15	4.6	0	0	$0.00	$0.00
16	4.6	0	0	$0.00	$0.00
17	4.6	0	0	$0.00	$0.00
18	4.6	0	0	$0.00	$0.00
19	4.6	0	0	$0.00	$0.00
20	4.6	0	0	$0.00	$0.00
21	4.6	0	0	$0.00	$0.00
22	4.6	0	0	$0.00	$0.00
23	4.6	0	0	$0.00	$0.00
24	4.6	0	0	$0.00	$0.00
25	4.6	0	0	$0.00	$0.00
Total	**115**	**0**	**0**	**$3.41**	**$0.00**

Resource Savings Assumptions

Annual Natural Gas Savings	**4.6**	m^3/Meal per Day

The savings associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of meals served per day, resulting in savings per meals served per day. See below for details.

One DWHR unit is connected to the dishwasher drain and used to preheat the water before the dishwasher water heater. A continuous flow dishwasher is used for the calculations.

The following are the characteristics used to estimate the drain water from the dishwashers:
Water Use per Meal:
= 9.1 (L/meal) 0* (1-70%) [1]
= 2.7 (L/meal)

Average restaurant size: 519 meals/day [2][3] Calculate based on the number of establishments in the area, market share and number of meals eaten out per day.
Percentage of water use per meal for dishwashers: 80% [4]

$$Yearly\ Concurrent\ Drainwater\ Flow$$
$$= 2.7\ (L/meal) \times 519\ (meals/day) \times 365\ (days/year) \times 80\%$$
$$= 408{,}893\ (L/year)$$

The energy that can be recovered and therefore natural gas saved is calculated based on the following factors:
Yearly concurrent drain water flow: see above calculation
Drain water temperature for dishwasher: 77°C [1]
Domestic Cold Water Temperature: 9.33 °C [5]
DWHR unit effectiveness for noted piping configuration: 60% [6]
Standard Natural gas water heater efficiency: 78%

$$Natural\ Gas\ Saving\ (m^3)$$
$$= \frac{408{,}893\ (L/year) \times 4.184\ (KJ/(Kg\ °C)) \times [77\ (°C) - 9.33\ (°C)] \times 60\ (\%)}{78\ (\%) \times 37230\ (KJ/m^3)}$$

$= 2{,}392(m^3/year)$

4.6 m^3/meal served per day = 2,392 m^3/year / 519 meals served per day per facility

Annual Electricity Savings	**0**	KWh/Meal per Day
N/A		
Annual Water Savings	**0**	L/Meal per Day
N/A		

Other Input Assumptions

Effective Useful Life (EUL)	**25**	Years
The DWHR units have a useful life in excess of 25 years. [6]		
Base & Incremental Conservation Measure Equipment and O&M Cost	**3.41**	$/Meal per Day
The costs associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average cost per meals served per day, resulting in a cost per meals served per day. DWHR unit cost: $1,030 [7] Installation: $740. This is calculated based on the materials, equipment and labour needed to install a unit, as estimated from RS Means. Maintenance: $0. DWHR is a passive technology and requires no maintenance similar to the piping systems that it is connected to. [8] $3.41 per meal served per day = ($1,030 + $740) / 519 meals served per day per facility		
Customer Payback Period (Natural Gas Only)	**2.5**	Years
Simple payback period, based on a natural gas price of $0.30/$m^3$.		

$$Simple\ Payback\ Period = \frac{Incremental\ Cost}{Natural\ Gas\ Savings \times Natural\ Gas\ Cost}$$

$$= \frac{3.41(\$)}{4.6\ (m^3) \times 0.3\ (\$/m^3)} = 2.5\ (years)$$

References

[1] The 9.1 (L/meal) value originates from ASHRAE Handbook 2007, HVAC Applications, Section 49 - Service Water Heating and is associated with a study from the 70's. This value was updated by multiplying it by one minus the % reduction in water use by Conveyor and Flight-Type machines since then, gathered from a manufacturer (Suzanne Supplee - Champion Industries/BiLine) and Genevieve Bussieres from Natural Gas Technology Centre (NGTC) quoting an NSF study and conversations with Hobart (another manufacturer). The 70% reduction in water use value was chosen for this calculation based on the above sources (68% from Champion and 70-72% from NGTC's findings).[2]

Natural Gas Technologies Centre, DSM Opportunities associated with Commercial Dishwashers, April 27 2009.

[3] Ebbin, J, Americans' Dining-Out Habits, Restaurant USA, November 2000. Available at http://www.restaurant.org/tools/magazines/rusa/magArchive/year/article/?ArticleID=138

[4] Wexiodisk, Rack Conveyor Dishwasher, 2006. Available at www.wexiodisk.com

[5] Cited in the following as personal communication with City of Toronto Works Dept. VEIC, Comments on Navigant's Draft Gas Measure Characterizations, March 2009.

[6] RenewABILITY Energy Inc., RenewABILITY Inc. Product Presentation, Delivered at Enermodal Engineering on November 2, 2009

[7] RenewABILITY Energy Inc.

[8] Enermodal Engineering, Development of DSM Measures and Market Information on Commercial Drain Water Heat Recovery, Rev 1., March 31, 2010

Drain Water Heat Recovery (DWHR) Units – Hospital, Dishwashing

New Construction

Description/Comment
Continuous Flow Dishwasher. Savings and Costs are shown per Bed.

Efficient Equipment and Technologies Description
Drain Water Heat Recovery (DWHR) pre-heats incoming domestic cold water with the available drain water heat that would otherwise be lost. This measure applies only to DWHR systems installed with Continuous Flow Dishwashers where there is concurrent hot water flow in and drain water flow out of the DWHR system.
Base Equipment and Technologies Description
None

Decision Type	Target Market	End Use
New Construction.	Hospital. Kitchen Dishwashing. Continuous Flow Dishwasher.	Water Heating

Codes, Standards and Regulations

None.

Resource Savings Table

	Electricity and other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3 / Bed)	Electricity (KWh / Bed)	Water (L / Bed)	($ / Bed)	($ / Bed)
1	12	0	0	$11.88	$0.00
2	12	0	0	$0.00	$0.00
3	12	0	0	$0.00	$0.00
4	12	0	0	$0.00	$0.00
5	12	0	0	$0.00	$0.00
6	12	0	0	$0.00	$0.00
7	12	0	0	$0.00	$0.00
8	12	0	0	$0.00	$0.00
9	12	0	0	$0.00	$0.00
10	12	0	0	$0.00	$0.00
11	12	0	0	$0.00	$0.00
12	12	0	0	$0.00	$0.00
13	12	0	0	$0.00	$0.00

14	12	0	0	$0.00	$0.00
15	12	0	0	$0.00	$0.00
16	12	0	0	$0.00	$0.00
17	12	0	0	$0.00	$0.00
18	12	0	0	$0.00	$0.00
19	12	0	0	$0.00	$0.00
20	12	0	0	$0.00	$0.00
21	12	0	0	$0.00	$0.00
22	12	0	0	$0.00	$0.00
23	12	0	0	$0.00	$0.00
24	12	0	0	$0.00	$0.00
25	12	0	0	$0.00	$0.00
Total	**311**	**0**	**0**	**$11.88**	**$0.00**

Resource Savings Assumptions

Annual Natural Gas Savings	**12**	m^3/Bed

The savings associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of beds in a hospital, resulting in savings per bed. See below for details.

One DWHR unit is connected to the dishwasher drain and used to preheat the water before the dishwasher water heater. A continuous flow dishwasher is used for the calculations.

The following are the characteristics used to estimate the drain water from the dishwashers:
Water Use per Meal:
=9.1 (L/meal) * (1-70%)) [1]
= 2.7 (L/meal)
Average hospital size: 149 beds [2]
Percentage of beds requiring meals: 75% [3]
Additional meals for staff: 20% [3]
Percentage of water use per meal for dishwashers: 80% [4]

$$\begin{aligned} &Yearly\ Concurrent\ Drainwater\ Flow \\ &= 2.7\ (L/meal) \times 3\ (meals/day) \times 365\ (days/year) \times 149\ (beds/hospital) \\ &\qquad \times 75\%\ (beds\ requiring\ meals) \times 120\%\ (staff\ meals) \times 80\% \\ &= 317{,}173\ (L/year) \end{aligned}$$

The energy that can be recovered and therefore natural gas saved is calculated based on the following factors:
Yearly concurrent drain water flow: see above calculation
Drain water temperature for dishwasher: 77°C [1]
Domestic Cold Water Temperature: 9.33 °C [5]
DWHR unit effectiveness for noted piping configuration: 60% [6]
Standard Natural gas water heater efficiency: 78%

$$Natural\ Gas\ Saving\ (m^3) = \frac{317{,}173\ (L/year)\ \times\ 4.184\ (KJ/(Kg\ ^\circ C))\ \times\ [77\ (^\circ C) - 9.33\ (^\circ C)]\ \times\ 60\ (\%)}{78\ (\%)\ \times\ 37230\ (KJ/m^3)}$$

$$= 1{,}856\ (m^3/year)$$

12 m3/yr per bed = 1,856m3/yr / 149 beds

Annual Electricity Savings	**0**	KWh/Bed
N/A		
Annual Water Savings	**0**	L/Bed
N/A		

Other Input Assumptions

Effective Useful Life (EUL)	**25**	Years
The DWHR units have a useful life in excess of 25 years. [6]		
Base & Incremental Conservation Measure Equipment and O&M Cost	**11.88**	$/Bed

The costs associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of beds per facility, resulting in a cost per bed.

DWHR unit cost: $1,030 [7]
Installation: $740. This is calculated based on the materials, equipment and labour needed to install a unit, as estimated from RS Means.
$11.88 = ($1,030 + $740)/149 beds/facility

Maintenance: $0. DWHR is a passive technology and requires no maintenance similar to the piping systems that it is connected to.[8]

Customer Payback Period (Natural Gas Only)	**3.3**	Years

Simple payback period, based on a natural gas price of $0.30/m^3$.

$$Simple\ Payback\ Period\ = \frac{Incremental\ Cost}{Natural\ Gas\ Savings\ \times\ Natural\ Gas\ Cost}$$

$$= \frac{11.88(\$)}{12\ (m^3) \times 0.3\ (\$/m^3)} = 3.3\ (years)$$

References

[1] The 9.1 (L/meal) value originates from ASHRAE Handbook 2007, HVAC Applications, Section 49 - Service Water Heating and is associated with a study from the 70's. This value was updated by multiplying it by one minus the % reduction in water use by Conveyor and Flight-Type machines since then, gathered from a manufacturer (Suzanne Supplee - Champion Industries/BiLine) and Genevieve Bussieres from Natural Gas Technology Centre (NGTC) quoting an NSF study and conversations with Hobart (another manufacturer). The 70% reduction in water use value was chosen for this calculation based on the above sources (68% from Champion and 70-72% from NGTC's findings).

[2] Ontario Hospital Association, Health System Facts and Figures- Beds Staffed and in Operation, Ontario, 2009. Available at http://www.healthsystemfacts.com

[3] Grand River Hospital - Diet Office of the Nutrition/Food Service Department

[4] Wexiodisk, Rack Conveyor Dishwasher, 2006. Available at www.wexiodisk.com

[5] Cited in the following as personal communication with City of Toronto Works Dept. VEIC, Comments on Navigant's Draft Gas Measure Characterizations, March 2009.

[6] RenewABILITY Energy Inc., RenewABILITY Inc. Product Presentation, Delivered at Enermodal Engineering on November 2, 2009

[7] RenewABILITY Energy Inc.

[8] Enermodal Engineering, Development of DSM Measures and Market Information on Commercial Drain Water Heat Recovery, Rev 1., March 31, 2010

Drain Water Heat Recovery (DWHR) Units – Hospital, Laundry

New Construction

Description/Comment
Laundry - with storage tank and pumping equipment. Savings and Costs are shown per Bed.

Efficient Equipment and Technologies Description
Drain Water Heat Recovery (DWHR) pre-heats incoming domestic cold water with the available drain water heat that would otherwise be lost. A storage tank and pumping equipment is needed for batch-style (ie. front load or top load) Laundry equipment to ensure cold water flows into the DWHR system and warm drain water flows out concurrently.
Base Equipment and Technologies Description
None

Decision Type	Target Market	End Use
New Construction	Hospital. On-premise Laundry. Laundry Equipment	Water Heating

Codes, Standards and Regulations

None.

Resource Savings Table

	Electricity and other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3/Bed)	Electricity (KWh/Bed)	Water (L/Bed)	($/Bed)	($/Bed)
1	295	0	0	$213.56	$0.00
2	295	0	0	$3.66	$0.00
3	295	0	0	$3.33	$0.00
4	295	0	0	$3.03	$0.00
5	295	0	0	$2.75	$0.00
6	295	0	0	$2.50	$0.00
7	295	0	0	$2.27	$0.00
8	295	0	0	$2.07	$0.00
9	295	0	0	$1.88	$0.00
10	295	0	0	$1.71	$0.00
11	295	0	0	$1.55	$0.00
12	295	0	0	$1.41	$0.00
13	295	0	0	$1.28	$0.00

14	295	0	0	$1.17	$0.00
15	295	0	0	$1.06	$0.00
16	295	0	0	$0.96	$0.00
17	295	0	0	$0.88	$0.00
18	295	0	0	$0.80	$0.00
19	295	0	0	$0.72	$0.00
20	295	0	0	$0.66	$0.00
21	295	0	0	$0.60	$0.00
22	295	0	0	$0.54	$0.00
23	295	0	0	$0.49	$0.00
24	295	0	0	$0.45	$0.00
25	295	0	0	$0.41	$0.00
Total	**7,365**	**0**	**0**	**$250**	**$0.00**

Resource Savings Assumptions

Annual Natural Gas Savings	**295**	m^3/Bed

The savings associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of beds in a hospital, resulting in savings per bed. See below for details.

One manifolded DWHR assembly (made of (4) units or pipes) is connected, with storage and pumping equipment to the on-premise laundry equipment in the hospital.

The following are the characteristics used to estimate the drain water from the laundry equipment:
Water Usage Rate: 9.5 L/lb [1]
Average hospital size: 149 beds [2]
Quantity of Laundry: 18 Lbs/Room/day [3]

$$Yearly\ Concurrent\ Drainwater\ Flow$$
$$= 9.5\ (L/lb)\ \times\ 18\ (lbs/room/day)\ \times 149\ (beds)\ \ \times\ 365\ (days)$$
$$= 9{,}299{,}835\ (L/year)$$

The energy that can be recovered and therefore natural gas saved is calculated based on the following factors:
Yearly concurrent drain water flow: see above calculation
Drain water temperature for laundry equipment: 70°C [4]
Domestic Cold Water Temperature: 9.33 °C [5]
DWHR unit effectiveness for noted piping configuration: 60% [6]
Storage losses derating factor: 90% [7]
Standard Natural gas water heater efficiency: 78%

$$Natural\ Gas\ Saving\ (m^3)$$
$$= \frac{9{,}299{,}835\ \left(\frac{L}{year}\right) \times\ 4.184\ \left(\frac{KJ}{Kg\ °C}\right) \times\ [70\ (°C) -\ 9.33\ (°C)] \times\ 60\ (\%) \times\ 90\ (\%)}{78\ (\%) \times\ 37230\ \left(\frac{KJ}{m^3}\right)}$$

$= 43{,}898\ (m^3/year)$ 295 m^3 per Bed = 43,898 m^3 / 149 Beds per facility		
Annual Electricity Savings	**0**	KWh/Bed
N/A		
Annual Water Savings	**0**	L/Bed
N/A		

Other Input Assumptions

Effective Useful Life (EUL)	**25**	Years
The DWHR units have a useful life in excess of 25 years. [6]		
Base & Incremental Conservation Measure Equipment and O&M Cost	**250**	$/Bed

The costs associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of beds per facility, resulting in a cost per bed.

DWHR assembly cost: $12,920.[8] One assembly made up of (4) units (pipes) is required.
Accessories cost: $13,500. Includes costs for pumps, storage tank, controls and other necessary equipment for non-concurrent flow applications.
Installation: $4,800. This is calculated based on the materials, equipment and labour needed to install a unit, as estimated from RS Means.
Maintenance: $600. DWHR is a passive technology and requires no maintenance similar to the piping systems that it is connected to.[9] However, the storage tank and pump will require yearly maintenance and the pump requires some energy to operate.
A discount rate of 10%, consistent with the TRC calculation, is applied to the yearly O&M cost, to calculate the NPV ($5991).

$250 per Bed = ($12,920 + $13,500 + $4,800 + $5,991)/ 149 Beds

Customer Payback Period (Natural Gas Only)	**2.5**	Years

Simple payback period, based on a natural gas price of $0.30/m^3.

$$Simple\ Payback\ Period\ = \frac{Incremental\ Cost}{Natural\ Gas\ Savings\ \times\ Natural\ Gas\ Cost - Yearly\ Cost}$$

$$= \frac{(\frac{31{,}220}{149\ Beds})(\$)}{295\ (m^3) \times 0.3\ \left(\frac{\$}{m^3}\right) - (\frac{600}{149\ Beds})\ (\$)} = 2.5\ (years)$$

References

[1] Alliance for Water Efficiency, Commercial Laundry Facilities Introduction, 2009. Available at http://www.allianceforwaterefficiency.org/commercial_laundry.aspx

[2] Ontario Hospital Association, Health System Facts and Figures- Beds Staffed and in Operation, Ontario, 2009.

Available at http://www.healthsystemfacts.com

[3] Department of Veteran Affairs, Veterans Health Administration: Environmental Management Service Laundry and Linen Operations, March 2008. Available at http://www.wbdg.org/ccb/VA/VASPACE/7610-408.pdf

[4] ASHRAE Handbook 2007, HVAC Applications, Section 49- Service Water Heating

[5] Cited in the following as personal communication with City of Toronto Works Dept. VEIC, Comments on Navigant's Draft Gas Measure Characterizations, March 2009.

[6] RenewABILITY Energy Inc., RenewABILITY Inc. Product Presentation, Delivered at Enermodal Engineering on November 2, 2009

[7] Value is from common industry practice, communication with Enermodal Engineering, November 2010.

[8] RenewABILITY Energy Inc.

[9] Enermodal Engineering, Development of DSM Measures and Market Information on Commercial Drain Water Heat Recovery, Rev 1., March 31, 2010

Drain Water Heat Recovery (DWHR) Units – Nursing Home, Dishwashing

New Construction

Description/Comment
Continuous Flow Dishwasher. Saving and Costs are shown per Bed.

Efficient Equipment and Technologies Description
Drain Water Heat Recovery (DWHR) pre-heats incoming domestic cold water with the available drain water heat that would otherwise be lost. This measure applies only to DWHR systems installed with Continuous Flow Dishwashers where there is concurrent hot water flow in and drain water flow out of the DWHR system.
Base Equipment and Technologies Description
None

Decision Type	Target Market	End Use
New Construction.	Nursing Home. Kitchen Dishwashing. Continuous Flow Dishwasher.	Water Heating

Codes, Standards and Regulations

None.

Resource Savings Table

	Electricity and other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3/Bed)	Electricity (KWh/Bed)	Water (L/Bed)	($/Bed)	($/Bed)
1	12	0	0	$16.54	$0.00
2	12	0	0	$0.00	$0.00
3	12	0	0	$0.00	$0.00
4	12	0	0	$0.00	$0.00
5	12	0	0	$0.00	$0.00
6	12	0	0	$0.00	$0.00
7	12	0	0	$0.00	$0.00
8	12	0	0	$0.00	$0.00
9	12	0	0	$0.00	$0.00
10	12	0	0	$0.00	$0.00
11	12	0	0	$0.00	$0.00
12	12	0	0	$0.00	$0.00
13	12	0	0	$0.00	$0.00

14	12	0	0	$0.00	$0.00
15	12	0	0	$0.00	$0.00
16	12	0	0	$0.00	$0.00
17	12	0	0	$0.00	$0.00
18	12	0	0	$0.00	$0.00
19	12	0	0	$0.00	$0.00
20	12	0	0	$0.00	$0.00
21	12	0	0	$0.00	$0.00
22	12	0	0	$0.00	$0.00
23	12	0	0	$0.00	$0.00
24	12	0	0	$0.00	$0.00
25	12	0	0	$0.00	$0.00
Total	**311**	**0**	**0**	**$16.54**	**$0.00**

Resource Savings Assumptions

Annual Natural Gas Savings	**12**	m^3/Bed

The savings associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of beds in a Nursing Home, resulting in savings per bed. See below for details.

One DWHR unit is connected to the dishwasher drain and used to preheat the water before the dishwasher water heater. A continuous flow dishwasher is used for the calculations.

The following are the characteristics used to estimate the drain water from the dishwashers:
Water Use per Meal:
=9.1 (L/meal) * (1-70%) [1]
= 2.7 (L/meal)Average Nursing Home size: 107 beds [2]
Percentage of beds requiring meals: 75% [3]
Additional meals for staff: 20% [3]
Percentage of water use per meal for dishwashers: 80% [4]

$$Yearly\ Concurrent\ Drainwater\ Flow$$
$$= 2.7\ (L/meal) \times 3\ (meals/day) \times 365\ (days/year) \times 107\ (\frac{beds}{Nursing\ Home}) \times 75\%\ \ (beds\ requiring\ meals) \times 120\%\ (staff\ meals) \times 80\%$$
$$= 227{,}769(L/year)$$

The energy that can be recovered and therefore natural gas saved is calculated based on the following factors:
Yearly concurrent drain water flow: see above calculation
Drain water temperature for dishwasher: 77°C [1]
Domestic Cold Water Temperature: 9.33 °C [5]
DWHR unit effectiveness for noted piping configuration: 60% [6]
Standard Natural gas water heater efficiency: 78%

$$Natural\ Gas\ Saving\ (m^3) = \frac{227{,}769\ (L/year) \times 4.184\ (KJ/(Kg\ °C)) \times [77\ (°C) - 9.33\ (°C)] \times 60\ (\%)}{78\ (\%) \times 37230\ (KJ/m^3)}$$
$$= 1{,}332(m^3/year)$$

12 m3/yr = 1,332 m3 / 107 Beds per facility

Annual Electricity Savings	**0**	KWh/Bed
N/A		
Annual Water Savings	**0**	L/Bed
N/A		

Other Input Assumptions

Effective Useful Life (EUL)	**25**	Years
The DWHR units have a useful life in excess of 25 years. [6]		
Base & Incremental Conservation Measure Equipment and O&M Cost	**16.54**	$/Bed

The costs associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of beds per facility, resulting in a cost per bed.

DWHR unit cost: $1,030 [7]
Installation: $740. This is calculated based on the materials, equipment and labour needed to install a unit, as estimated from RS Means.
Maintenance: $0. DWHR is a passive technology and requires no maintenance similar to the piping systems that it is connected to.[8]

$16.54 / Bed = $1,030 + $740)/107 Beds per facility

Customer Payback Period (Natural Gas Only)	**4.6**	Years

Simple payback period, based on a natural gas price of $0.30/m^3.

$$Simple\ Payback\ Period = \frac{Incremental\ Cost}{Natural\ Gas\ Savings \times Natural\ Gas\ Cost}$$

$$= \frac{16.54(\$)}{12\ (m^3) \times 0.3\ (\$/m^3)} = 4.6\ (years)$$

References

[1] The 9.1 (L/meal) value originates from ASHRAE Handbook 2007, HVAC Applications, Section 49 - Service Water Heating and is associated with a study from the 70's. This value was updated by multiplying it by one minus the % reduction in water use by Conveyor and Flight-Type machines since then, gathered from a manufacturer (Suzanne Supplee - Champion Industries/BiLine) and Genevieve Bussieres from Natural Gas Technology Centre (NGTC) quoting an NSF study and conversations with Hobart (another manufacturer). The 70% reduction in water use value was chosen for this calculation based on the above sources (68% from Champion and 70-72% from NGTC's findings).

[2] American Health Care Association, Trends in Nursing Facility Characteristics, December 2009. Available at http://www.ahcancal.org/Pages/Default.aspx

[3] Grand River Hospital - Diet Office of the Nutrition/Food Service Department.

[4] Wexiodisk, Rack Conveyor Dishwasher, 2006. Available at www.wexiodisk.com

[5] Cited in the following as personal communication with City of Toronto Works Dept. VEIC, Comments on Navigant's Draft Gas Measure Characterizations, March 2009.

[6] RenewABILITY Energy Inc., RenewABILITY Inc. Product Presentation, Delivered at Enermodal Engineering on November 2, 2009

[7] RenewABILITY Energy Inc.

[8] Enermodal Engineering, Development of DSM Measures and Market Information on Commercial Drain Water Heat Recovery, Rev 1., March 31, 2010

Drain Water Heat Recovery (DWHR) Units – Laundromat

Retrofit

Description/Comment
Laundry – with storage tank and pumping equipment. Savings and Costs are Shown per Laundromat.

Efficient Equipment and Technologies Description
Drain Water Heat Recovery (DWHR) pre-heats incoming domestic cold water with the available drain water heat that would otherwise be lost. A storage tank and pumping equipment is needed for batch-style (i.e., front load or top load) Laundry equipment to ensure cold water flows into the DWHR system and warm drain water flows out concurrently.
Base Equipment and Technologies Description
None

Decision Type	Target Market	End Use
Retrofit	Laundromat. Laundry Equipment	Water Heating

Codes, Standards and Regulations

None.

Resource Savings Table

	Electricity and other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (KWh)	Water (L)	($)	($)
1	49,735	0	0	$35,420.00	$0.00
2	49,735	0	0	$545.45	$0.00
3	49,735	0	0	$495.87	$0.00
4	49,735	0	0	$450.79	$0.00
5	49,735	0	0	$409.81	$0.00
6	49,735	0	0	$372.55	$0.00
7	49,735	0	0	$338.68	$0.00
8	49,735	0	0	$307.89	$0.00
9	49,735	0	0	$279.90	$0.00
10	49,735	0	0	$254.46	$0.00
11	49,735	0	0	$231.33	$0.00
12	49,735	0	0	$210.30	$0.00
13	49,735	0	0	$191.18	$0.00
14	49,735	0	0	$173.80	$0.00

15	49,735	0	0	$158.00	$0.00
16	49,735	0	0	$143.64	$0.00
17	49,735	0	0	$130.58	$0.00
18	49,735	0	0	$118.71	$0.00
19	49,735	0	0	$107.92	$0.00
20	49,735	0	0	$98.10	$0.00
21	49,735	0	0	$89.19	$0.00
22	49,735	0	0	$81.08	$0.00
23	49,735	0	0	$73.71	$0.00
24	49,735	0	0	$67.01	$0.00
25	49,735	0	0	$60.92	$0.00
Total	**1,243,364**	**0**	**0**	**$40,811**	**$0.00**

Resource Savings Assumptions

Annual Natural Gas Savings	**49,735**	m^3

One manifolded DWHR assembly (made of (4) units or pipes) is connected, with storage and pumping equipment to the laundry equipment.

The following are the characteristics used to estimate the drain water from the laundry equipment:
Laundry Rate: 0.37 Loads/person/day [1]
Water Usage Rate: 60 L/load[2]
Consumer base for Laundromat: 1303 [3][4][5] Based on the number of Laundromats in the service area and the number of persons who use Laundromats.

$$Yearly\ Concurrent\ Drainwater\ Flow = 0.37\ (Loads/person/day) \times 60\ (L/load) \times 1303\ (persons) \times 365\ (days) = 10{,}536{,}258\ (L/year)$$

The energy that can be recovered and therefore natural gas saved is calculated based on the following factors:
Yearly concurrent drain water flow: see above calculation
Drain water temperature for laundry equipment: 70°C [6]
Domestic Cold Water Temperature: 9.33 °C [7]
DWHR unit effectiveness for noted piping configuration: 60% [8]
Storage losses derating factor: 90% [9]
Standard Natural gas water heater efficiency: 78%

$$Natural\ Gas\ Saving\ (m^3) = \frac{10{,}536{,}258\ \left(\frac{L}{year}\right) \times\ 4.184\ \left(\frac{KJ}{Kg\ °C}\right) \times\ [70\ (°C) - 9.33\ (°C)] \times\ 60\ (\%) \times\ 90\ (\%)}{78\ (\%) \times\ 37230\ \left(\frac{KJ}{m^3}\right)} = 49{,}735\ (m^3/year)$$

Annual Electricity Savings	**0**	KWh
N/A		

Annual Water Savings	**0**	L
N/A		

Other Input Assumptions

Effective Useful Life (EUL)	**25**	Years
The DWHR units have a useful life in excess of 25 years. [8]		
Base & Incremental Conservation Measure Equipment and O&M Cost	**40,811**	$
DWHR assembly cost: $12,920.[10] One assembly made up of (4) units (pipes) is required in this case. Accessories cost: $13,500. Includes costs for pumps, storage tank, controls and other necessary equipment for non-concurrent flow applications. Installation: $8,400. This is calculated based on the materials, equipment and labour needed to install a unit, in an existing building, as estimated from RS Means. Maintenance: $600. DWHR is a passive technology and requires no maintenance similar to the piping systems that it is connected to.[8] However, the storage tank and pump will require yearly maintenance and the pump requires some energy to operate.[11] A discount rate of 10%, consistent with the TRC calculation, is applied to the yearly O&M cost, to calculate the NPV ($5991). $40,811 = $12,920 + $13,500 + $8,400 + $5991.		
Number of DWHR Units for Reported Savings	**4**	Units
One manifolded DWHR assembly is required to handle the high flow rates for the laundry equipment. There are 4 DWHR units per assembly. The savings and payback are based on this configuration, which is representative of an average laundromat..		
Customer Payback Period (Natural Gas Only)	**2.4**	Years
Simple payback period, based on a natural gas price of $0.30/m^3.		

$$Simple\ Payback\ Period\ = \frac{Incremental\ Cost}{Natural\ Gas\ Savings\ \times\ Natural\ Gas\ Cost - Yearly\ Cost}$$

$$= \frac{34{,}820(\$)}{49{,}735\ (m^3) \times 0.3\ (\$/m^3) -\ 600\ (\$)} = 2.4\ (years)$$

References

[1] Gleick, P.H., et al. Waste Not, Want Not: The Potential for Urban Water Conservation in California. Pacific Institute: Oakland, California, 2003.

[2] Speed Queen, Front Load Washer Horizon Line Product Brochure, 2010. Available at www.speedqueen.com

[3] Buertime, Industry Overview- Coin Operated Laundry, 2010. Available at http://buyertime.com/Laundry.html

[4] Coin Laundry Association, Industry Overview, 2006. Available at http://coinlaundry.org/resources/industryoverview.cfm

[5] Statistics Canada, Study: Changes and Challenges for Canada's Residential Real Estate Landlords, The Daily, May 25 2007. Available at http://www.statcan.gc.ca/daily-quotidien/070525/dq070525b-eng.htm

[6] ASHRAE Handbook 2007, HVAC Applications, Section 49- Service Water Heating

[7] Cited in the following as personal communication with City of Toronto Works Dept. VEIC, Comments on Navigant's Draft Gas Measure Characterizations, March 2009.

[8] RenewABILITY Energy Inc., RenewABILITY Inc. Product Presentation, Delivered at Enermodal Engineering on November 2, 2009

[9] Value is from common industry practice, communication with Enermodal Engineering, November 2010.

[10] RenewABILITY Energy Inc.

[11] Enermodal Engineering, Development of DSM Measures and Market Information on Commercial Drain Water Heat Recovery, Rev 1., March 31, 2010

Drain Water Heat Recovery (DWHR) Units – Arena, Showering

Retrofit

Description/Comment
Showering. Savings and Costs are shown per Showerhead.

Efficient Equipment and Technologies Description
Drain Water Heat Recovery (DWHR) pre-heats incoming domestic cold water with the available drain water heat that would otherwise be lost.
Base Equipment and Technologies Description
None

Decision Type	Target Market	End Use
Retrofit	Existing Recreation Facility/ Arena. Showering.	Water Heating

Codes, Standards and Regulations

None.

Resource Savings Table

	Electricity and other Resource Savings			Equipment & O&M Costs of Conservation Measure ($/showerhead)	Equipment & O&M Costs of Base Measure ($/showerhead)
Year (EUL=)	Natural Gas (m^3/ showerhead)	Electricity (KWh/ showerhead)	Water (L/ showerhead)		
1	394	0	0	$1,209	$0.00
2	394	0	0	$0.00	$0.00
3	394	0	0	$0.00	$0.00
4	394	0	0	$0.00	$0.00
5	394	0	0	$0.00	$0.00
6	394	0	0	$0.00	$0.00
7	394	0	0	$0.00	$0.00
8	394	0	0	$0.00	$0.00
9	394	0	0	$0.00	$0.00
10	394	0	0	$0.00	$0.00
11	394	0	0	$0.00	$0.00
12	394	0	0	$0.00	$0.00
13	394	0	0	$0.00	$0.00
14	394	0	0	$0.00	$0.00

15	394	0	0	$0.00	$0.00
16	394	0	0	$0.00	$0.00
17	394	0	0	$0.00	$0.00
18	394	0	0	$0.00	$0.00
19	394	0	0	$0.00	$0.00
20	394	0	0	$0.00	$0.00
21	394	0	0	$0.00	$0.00
22	394	0	0	$0.00	$0.00
23	394	0	0	$0.00	$0.00
24	394	0	0	$0.00	$0.00
25	394	0	0	$0.00	$0.00
Total	**9,848**	**0**	**0**	**$1,209**	**$0.00**

Resource Savings Assumptions

Annual Natural Gas Savings	**394**	m^3/showerhead

The savings associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of showerheads, resulting in savings per showerhead. This will allow for different system sizes. See below for details.

One DWHR assembly (with 2 pipes) is connected to the showers in the change rooms of the facility.

The following are the characteristics used to estimate the drain water from showers :
Showerhead flow rate: 4.7 L/min (1.25 GPM)[1]
Shower Usage Rate: 10% [2] Amount of time shower is in use.
Facility Hours of Operation: 16 hours per day [3]
Showers per Facility: 12 showers/facility [4]

$$Yearly\ Concurrent\ Drainwater\ Flow = 4.7\ (L/min) \times 16\ (hours/day) \times 60\ (min/hour) \times 365\ (days/year) \times 10\% \times 12\ (showers/facility) = 1{,}976{,}256\ (L/year)$$

The energy that can be recovered and therefore natural gas saved is calculated based on the following factors:
Yearly concurrent drain water flow: see above calculation
Drain water temperature for showers: 37°C [5]
Domestic Cold Water Temperature: 9.33 °C [6]
DWHR unit effectiveness for noted piping configuration: 60% [7]
Standard Natural gas water heater efficiency: 78%

$$Natural\ Gas\ Saving\ (m^3) = \frac{1{,}976{,}256\ (L/year/facility) \times 4.184\ (KJ/(Kg\ °C)) \times [37\ (°C) - 9.33\ (°C)] \times 60\ (\%)}{78\ (\%) \times 37230\ (KJ/m^3)}$$

$$= 4{,}727\ (m^3/year)$$

394 m3/yr per showerhead = 4,727 m3 / 12 showers/facility

Annual Electricity Savings	**0**	KWh/showerhead

N/A

Annual Water Savings	**0**	L/showerhead

N/A

Other Input Assumptions

Effective Useful Life (EUL)	**25**	Years
The DWHR units have a useful life in excess of 25 years. [7]		
Base & Incremental Conservation Measure Equipment and O&M Cost	**1,209**	$/showerhead
The costs associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of showerheads, resulting in costs per showerhead. DWHR assembly cost: $5,510. One assembly with 2 DWHR units (pipes) is required in this case.[8][9][10] Installation: $9,000 (total). This is calculated based on the materials, equipment and labour needed to install a unit, in an existing building, as estimated from RS Means. $1,209 per showerhead = ($5,510 + $9,000)/12 showers/facility Maintenance: $0. DWHR is a passive technology and requires no maintenance similar to the piping systems that it is connected to.		
Customer Payback Period (Natural Gas Only)	**10.2**	Years
Simple payback period, based on a natural gas price of $\$0.30/m^3$.		

$$Simple\ Payback\ Period\ = \frac{Incremental\ Cost}{Natural\ Gas\ Savings\ \times\ Natural\ Gas\ Cost}$$

$$= \frac{1{,}209(\$)}{394\ (m^3) \times 0.3\ (\$/m^3)} = 10.2\ (years)$$

References

[1] 1.25 GPM showerheads were used based on the likelihood of the facility participating in the low-flow showerhead program. This was agreed to by UG and their Evaluation and Audit Committee in November-December 2010.

[2] Ontario Recreation Facility Association (ORFA) indicated half of the showers are “on” 10-15 minutes/hr on average. This value will be higher for weekends and primetime periods. 10% = 12.5 minutes “on” / 60 minutes * 50% of showers

[3] Based on survey of typical rinks by Enermodal, corroborated with a web search of five rinks by UG.

[4] The typical maximum number of showers that can be ganged is 12. This is based on Enermodal’s discussions with DWHR suppliers.

[5] ASHRAE Handbook 2007, <u>HVAC Applications</u>, Section 49 - Service Water Heating

[6] Cited in the following as personal communication with City of Toronto Works Dept. VEIC, Comments on Navigant’s Draft

Gas Measure Characterizations, March 2009.

[7] RenewABILITY Energy Inc., RenewABILITY Inc. Product Presentation, Delivered at Enermodal Engineering on November 2, 2009

[8] The number of assemblies required is based on the DWHR supplier RenewABILITY Energy Inc. and modified to account for the installation of low flow showerheads (1.25 GPM) instead of typical showerheads in agreement with the research contractor, Enermodal. Low flow showerheads are expected to be half the flow rate of typical showerheads.

[9] Enermodal Engineering, Development of DSM Measures and Market Information on Commercial Drain Water Heat Recovery, Rev 1., March 31, 2010

[10] The original report from Enermodal required two assemblies to service 12 typical flow showerheads. However, after the report, the showerhead flow rates were reduced by 50% (to 1.25 GPM). DWHR systems are sized according to flow rate, so if the flow rate is half of the original, the number of DWHR assemblies required will be half as well. Enermodal agreed to reduce the number of DWHR assemblies from two to one, which reduces the cost of the equipment by 50%.

Drain Water Heat Recovery (DWHR) Units – University/College Cafeterias, Dishwashing

Retrofit

Description/Comment
Continuous Flow Dishwasher. Savings and Costs are shown per Meal Served per Day.

Efficient Equipment and Technologies Description
Drain Water Heat Recovery (DWHR) pre-heats incoming domestic cold water with the available drain water heat that would otherwise be lost. This measure applies only to DWHR systems installed with Continuous Flow Dishwashers where there is concurrent hot water flow in and drain water flow out of the DWHR system.
Base Equipment and Technologies Description
None

Decision Type	Target Market	End Use
Retrofit	University/College Cafeterias. Kitchen Dishwashing. Continuous Flow Dishwashers	Water Heating

Codes, Standards and Regulations

None.

Resource Savings Table

	Electricity and other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3/Meal per Day)	Electricity (KWh/Meal per Day)	Water (L/Meal per Day)	($/Meal per Day)	($/Meal per Day)
1	11.6	0	0	$6.26	$0.00
2	11.6	0	0	$0.00	$0.00
3	11.6	0	0	$0.00	$0.00
4	11.6	0	0	$0.00	$0.00
5	11.6	0	0	$0.00	$0.00
6	11.6	0	0	$0.00	$0.00
7	11.6	0	0	$0.00	$0.00
8	11.6	0	0	$0.00	$0.00
9	11.6	0	0	$0.00	$0.00
10	11.6	0	0	$0.00	$0.00
11	11.6	0	0	$0.00	$0.00

12	11.6	0	0	$0.00	$0.00
13	11.6	0	0	$0.00	$0.00
14	11.6	0	0	$0.00	$0.00
15	11.6	0	0	$0.00	$0.00
16	11.6	0	0	$0.00	$0.00
17	11.6	0	0	$0.00	$0.00
18	11.6	0	0	$0.00	$0.00
19	11.6	0	0	$0.00	$0.00
20	11.6	0	0	$0.00	$0.00
21	11.6	0	0	$0.00	$0.00
22	11.6	0	0	$0.00	$0.00
23	11.6	0	0	$0.00	$0.00
24	11.6	0	0	$0.00	$0.00
25	11.6	0	0	$0.00	$0.00
Total	**290**	**0**	**0**	**$6.26**	**$0.00**

Resource Savings Assumptions

Annual Natural Gas Savings	**11.6**	m^3/Meal per Day

The savings associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of meals served per day, resulting in savings per meals served per day. See below for details.

One DWHR unit is connected to the dishwasher drain and used to preheat the water before the dishwasher water heater. A continuous flow dishwasher is used for the calculations. The following are the characteristics used to estimate the drain water from the dishwashers:
Water Use per Meal:
= 9.1 (L/meal) * (1-70%)/(1-60%) [1]
= 6.8 (L/meal)
Average restaurant size: 519 meals/day [2][3] Calculate based on the number of establishments in the area, market share and number of meals eaten out per day.
Percentage of water use per meal for dishwashers: 80% [4]

$$Yearly\ Concurrent\ Drainwater\ Flow$$
$$= 6.8\ (L/meal) \times 519\ (meals/day) \times 365\ (days/year) \times 80\%$$
$$= 1{,}029{,}805\ (L/year)$$

The energy that can be recovered and therefore natural gas saved is calculated based on the following factors:
Yearly concurrent drain water flow: see above calculation
Drain water temperature for dishwasher: 77°C [1]
Domestic Cold Water Temperature: 9.33 °C [5]
DWHR unit effectiveness for noted piping configuration: 60% [6]
Standard Natural gas water heater efficiency: 78%

$$Natural\ Gas\ Saving\ (m^3) = \frac{1{,}029{,}805\ (L/year) \times 4.184\ (KJ/(Kg\ °C)) \times [77\ (°C) - 9.33\ (°C)] \times 60\ (\%)}{78\ (\%) \times 37230\ (KJ/m^3)}$$
$$= 6{,}024 (m^3/year)$$

11.6 m3/meal served per day = 6,024m3/year / 519 meals served per day per facility		
Annual Electricity Savings	**0**	KWh/Meal per Day
N/A		
Annual Water Savings	**0**	L/Meal per Day
N/A		

Other Input Assumptions

Effective Useful Life (EUL)	**25**	Years
The DWHR units have a useful life in excess of 25 years. [6]		
Base & Incremental Conservation Measure Equipment and O&M Cost	**6.26**	$/Meal per Day
The costs associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average cost per meals served per day, resulting in a cost per meals served per day. DWHR unit cost: $1,030 [7] Installation: $2,220. This is calculated based on the materials, equipment and labour needed to install a unit, in an existing building, as estimated from RS Means. Maintenance: $0. DWHR is a passive technology and requires no maintenance similar to the piping systems that it is connected to.[8] $6.26 per meal served per day = ($1,030 + $2,220)/519 meals served per day per facility		
Customer Payback Period (Natural Gas Only)	**1.8**	Years
Simple payback period, based on a natural gas price of $0.30/m^3.		

$$Simple\ Payback\ Period = \frac{Incremental\ Cost}{Natural\ Gas\ Savings \times Natural\ Gas\ Cost}$$

$$= \frac{6.26(\$)}{11.6\ (m^3) \times 0.3\ (\$/m^3)} = 1.8\ (years)$$

References

[1] The 9.1 (L/meal) value originates from the ASHRAE Handbook 2007, HVAC Applications, Section 49 - Service Water Heating and is associated with a study from the 70's. This value was updated to reflect water use from middle-aged equipment as expected in existing buildings. Machines in existing buildings are expected to be typically 10 years old based on the equipment life of 20 years, which in-turn came from the Food Service Technology Center (FSTC) as cited in NGTC, DSM OPPORTUNITIES ASSOCIATED WITH COMMERCIAL DISHWASHERS, Final Report, April 27, 2009, pg 17.).

In order to take this into account, the 9.1 value was multiplied by one minus the 70% reduction in water use by Conveyor and Flight-Type machines since the 70's, then divided by one minus the 60% reduction in water-use of new machines vs. machines built 10 years ago. This data was gathered from a manufacturer (Suzanne Supplee - Champion Industries/BiLine) and Genevieve Bussieres from the Natural Gas Technology Centre (NGTC) quoting an NSF study and conversations with Hobart (another manufacturer). The 70% reduction in water use value was chosen for this calculation based on the above sources (68% from Champion and 70-72% from NGTC's findings). The 60% reduction value was chosen based on the same sources (61% from Champion and 58% from NGTC's findings).

[2] Natural Gas Technologies Centre, DSM Opportunities associated with Commercial Dishwashers, April 27 2009.

[3] Ebbin, J, Americans' Dining-Out Habits, Restaurant USA, November 2000. Available at http://www.restaurant.org/tools/magazines/rusa/magArchive/year/article/?ArticleID=138

[4] Wexiodisk, Rack Conveyor Dishwasher, 2006. Available at www.wexiodisk.com

[5] Cited in the following as personal communication with City of Toronto Works Dept. VEIC, Comments on Navigant's Draft Gas Measure Characterizations, March 2009.

[6] RenewABILITY Energy Inc., RenewABILITY Inc. Product Presentation, Delivered at Enermodal Engineering on November 2, 2009

[7] RenewABILITY Energy Inc.

[8] Enermodal Engineering, Development of DSM Measures and Market Information on Commercial Drain Water Heat Recovery, Rev 1., March 31, 2010

Drain Water Heat Recovery (DWHR) Units – Hospital, Dishwashing

Retrofit

Description/Comment
Continuous Flow Dishwasher. Savings and Costs are shown per Bed.

Efficient Equipment and Technologies Description
Drain Water Heat Recovery (DWHR) pre-heats incoming domestic cold water with the available drain water heat that would otherwise be lost. This measure applies only to DWHR systems installed with Continuous Flow Dishwashers where there is concurrent hot water flow in and drain water flow out of the DWHR system.
Base Equipment and Technologies Description
None

Decision Type	Target Market	End Use
Retrofit	Existing Hospital. Kitchen Dishwashing. Continuous Flow Dishwashers.	Water Heating

Codes, Standards and Regulations

None.

Resource Savings Table

	Electricity and other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3 / Bed)	Electricity (KWh / Bed)	Water (L / Bed)	($ / Bed)	($ / Bed)
1	31	0	0	$18.19	$0.00
2	31	0	0	$0.00	$0.00
3	31	0	0	$0.00	$0.00
4	31	0	0	$0.00	$0.00
5	31	0	0	$0.00	$0.00
6	31	0	0	$0.00	$0.00
7	31	0	0	$0.00	$0.00
8	31	0	0	$0.00	$0.00
9	31	0	0	$0.00	$0.00
10	31	0	0	$0.00	$0.00
11	31	0	0	$0.00	$0.00
12	31	0	0	$0.00	$0.00
13	31	0	0	$0.00	$0.00

14	31	0	0	$0.00	$0.00
15	31	0	0	$0.00	$0.00
16	31	0	0	$0.00	$0.00
17	31	0	0	$0.00	$0.00
18	31	0	0	$0.00	$0.00
19	31	0	0	$0.00	$0.00
20	31	0	0	$0.00	$0.00
21	31	0	0	$0.00	$0.00
22	31	0	0	$0.00	$0.00
23	31	0	0	$0.00	$0.00
24	31	0	0	$0.00	$0.00
25	31	0	0	$0.00	$0.00
Total	**775**	**0**	**0**	**$18.19**	**$0.00**

Resource Savings Assumptions

Annual Natural Gas Savings	**31**	m^3/Bed

The savings associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of beds in a hospital, resulting in savings per bed. See below for details.

One DWHR unit is connected to the dishwasher drain and used to preheat the water before the dishwasher water heater. A continuous flow dishwasher is used for the calculations.

The following are the characteristics used to estimate the drain water from the dishwashers:
Water Use per Meal
= 9.1 (L/meal) * (1-70%)/(1-60%) [1]
= 6.8 (L/meal)
Average hospital size: 149 beds [2]
Percentage of beds requiring meals: 75% [3]
Additional meals for staff: 20% [3]
Percentage of water use per meal for dishwashers: 80% [4]

$$\begin{aligned} &Yearly\ Concurrent\ Drainwater\ Flow \\ &= 6.8\ (L/meal) \times 3\ (meals/day) \times 365\ (days/year) \times 149\ (beds/hospital) \\ &\qquad \times 75\%\ (beds\ requiring\ meals) \times 120\%\ (staff\ meals) \times 80\% \\ &= 798{,}807\ (L/year) \end{aligned}$$

The energy that can be recovered and therefore natural gas saved is calculated based on the following factors:
Yearly concurrent drain water flow: see above calculation
Drain water temperature for dishwasher: 77°C [1]
Domestic Cold Water Temperature: 9.33 °C [5]
DWHR unit effectiveness for noted piping configuration: 60% [6]
Standard Natural gas water heater efficiency: 78%

$$\begin{aligned} &Natural\ Gas\ Saving\ (m^3) \\ &= \frac{798{,}807\ (L/year) \times 4.184\ (KJ/(Kg\ ^\circ C)) \times [77\ (^\circ C) - 9.33\ (^\circ C)] \times 60\ (\%)}{78\ (\%) \times 37230\ (KJ/m^3)} \\ &= 4{,}673\ (m^3/year) \end{aligned}$$

$31m^3$ per bed = 4,673 m^3 / 149 beds per facility		
Annual Electricity Savings	0	KWh/Bed
N/A		
Annual Water Savings	0	L/Bed
N/A		

Other Input Assumptions

Effective Useful Life (EUL)	25	Years
The DWHR units have a useful life in excess of 25 years. [6]		
Base & Incremental Conservation Measure Equipment and O&M Cost	18.19	$/Bed
The costs associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of beds per facility, resulting in a cost per bed. DWHR unit cost: $1,030 [7] Installation: $1,680. This is calculated based on the materials, equipment and labour needed to install a unit, in an existing building, as estimated from RS Means. Maintenance: $0. DWHR is a passive technology and requires no maintenance similar to the piping systems that it is connected to.[8] $18.19 per bed = ($1,030 + $1,680) / 149 beds per facility		
Customer Payback Period (Natural Gas Only)	1.9	Years
Simple payback period, based on a natural gas price of $0.30/m^3$.		

$$Simple\ Payback\ Period\ = \frac{Incremental\ Cost}{Natural\ Gas\ Savings\ \times\ Natural\ Gas\ Cost}$$
$$= \frac{18.19(\$)}{31\ (m^3) \times 0.3\ (\$/m^3)} = 1.9\ (years)$$

References

[1] The 9.1 (L/meal) value originates from the ASHRAE Handbook 2007, HVAC Applications, Section 49 - Service Water Heating and is associated with a study from the 70's. This value was updated to reflect water use from middle-aged equipment as expected in existing buildings. Machines in existing buildings are expected to be typically 10 years old based on the equipment life of 20 years, which in-turn came from the Food Service Technology Center (FSTC) as cited in NGTC, DSM OPPORTUNITIES ASSOCIATED WITH COMMERCIAL DISHWASHERS, Final Report, April 27, 2009, pg 17.).

In order to take this into account, the 9.1 value was multiplied by one minus the 70% reduction in water use by Conveyor and Flight-Type machines since the 70's, then divided by one minus the 60% reduction in water-use of new machines vs. machines built 10 years ago. This data was gathered from a manufacturer (Suzanne Supplee - Champion

Industries/BiLine) and Genevieve Bussieres from the Natural Gas Technology Centre (NGTC) quoting an NSF study and conversations with Hobart (another manufacturer). The 70% reduction in water use value was chosen for this calculation based on the above sources (68% from Champion and 70-72% from NGTC's findings). The 60% reduction value was chosen based on the same sources (61% from Champion and 58% from NGTC's findings). [2] Ontario Hospital Association, Health System Facts and Figures- Beds Staffed and in Operation, Ontario, 2009. Available at http://www.healthsystemfacts.com

[3] Grand River Hospital - Diet Office of the Nutrition/Food Service Department

[4] Wexiodisk, Rack Conveyor Dishwasher, 2006. Available at www.wexiodisk.com

[5] Cited in the following as personal communication with City of Toronto Works Dept. VEIC, Comments on Navigant's Draft Gas Measure Characterizations, March 2009.

[6] RenewABILITY Energy Inc., RenewABILITY Inc. Product Presentation, Delivered at Enermodal Engineering on November 2, 2009

[7] RenewABILITY Energy Inc.

[8] Enermodal Engineering, Development of DSM Measures and Market Information on Commercial Drain Water Heat Recovery, Rev 1., March 31, 2010

Drain Water Heat Recovery (DWHR) Units – Hospital, Laundry

Retrofit

Description/Comment
Laundry - with storage tank and pumping equipment. Savings and Costs are shown per Bed.

Efficient Equipment and Technologies Description
Drain Water Heat Recovery (DWHR) pre-heats incoming domestic cold water with the available drain water heat that would otherwise be lost. A storage tank and pumping equipment is needed for batch-style (ie. front load or top load) Laundry equipment to ensure cold water flows into the DWHR system and warm drain water flows out concurrently.
Base Equipment and Technologies Description
None

Decision Type	Target Market	End Use
Retrofit	Existing Hospital. On-premise Laundry. Laundry Equipment.	Water Heating

Codes, Standards and Regulations

None.

Resource Savings Table

	Electricity and other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3/Bed)	Electricity (KWh/Bed)	Water (L/Bed)	($/Bed)	($/Bed)
1	295	0	0	$237.72	$0.00
2	295	0	0	$3.66	$0.00
3	295	0	0	$3.33	$0.00
4	295	0	0	$3.03	$0.00
5	295	0	0	$2.75	$0.00
6	295	0	0	$2.50	$0.00
7	295	0	0	$2.27	$0.00
8	295	0	0	$2.07	$0.00
9	295	0	0	$1.88	$0.00
10	295	0	0	$1.71	$0.00
11	295	0	0	$1.55	$0.00
12	295	0	0	$1.41	$0.00
13	295	0	0	$1.28	$0.00

14	295	0	0	$1.17	$0.00
15	295	0	0	$1.06	$0.00
16	295	0	0	$0.96	$0.00
17	295	0	0	$0.88	$0.00
18	295	0	0	$0.80	$0.00
19	295	0	0	$0.72	$0.00
20	295	0	0	$0.66	$0.00
21	295	0	0	$0.60	$0.00
22	295	0	0	$0.54	$0.00
23	295	0	0	$0.49	$0.00
24	295	0	0	$0.45	$0.00
25	295	0	0	$0.41	$0.00
Total	**7,365**	**0**	**0**	**$274**	**$0.00**

Resource Savings Assumptions

Annual Natural Gas Savings	**295**	m^3/Bed

The savings associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of beds in a hospital, resulting in savings per bed. See below for details.

One manifolded DWHR assembly (made of (4) units or pipes) is connected with storage and pumping equipment to the on-premise laundry equipment in the hospital.

The following are the characteristics used to estimate the drain water from the laundry equipment:
Water Usage Rate: 9.5 L/lb [1]
Average hospital size: 149 beds [2]
Quantity of Laundry: 18 Lbs/Room/day [3]

$$Yearly\ Concurrent\ Drainwater\ Flow$$
$$= 9.5\ (L/lb) \times 18\ (lbs/room/day) \times 149\ (beds) \times 365\ (days)$$
$$= 9{,}299{,}835\ (L/year)$$

The energy that can be recovered and therefore natural gas saved is calculated based on the following factors:
Yearly concurrent drain water flow: see above calculation
Drain water temperature for laundry equipment: 70°C [4]
Domestic Cold Water Temperature: 9.33 °C [5]
DWHR unit effectiveness for noted piping configuration: 60% [6]
Storage losses derating factor: 90% [7]
Standard Natural gas water heater efficiency: 78%

$$Natural\ Gas\ Saving\ (m^3)$$
$$= \frac{9{,}299{,}835\ \left(\frac{L}{year}\right) \times 4.184\ \left(\frac{KJ}{Kg\ °C}\right) \times [70\ (°C) - 9.33\ (°C)] \times 60\ (\%) \times 90\ (\%)}{78\ (\%) \times 37230\ \left(\frac{KJ}{m^3}\right)}$$
$$= 43{,}898\ (m^3/year)$$

295 m3 per Bed = 43,898 m3 / 149 Beds per facility

Annual Electricity Savings	**0**	KWh/Bed

N/A

Annual Water Savings	0	L/Bed
N/A		

Other Input Assumptions

Effective Useful Life (EUL)	25	Years
The DWHR units have a useful life in excess of 25 years. [6]		
Base & Incremental Conservation Measure Equipment and O&M Cost	274	$/Bed

The costs associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of beds per facility, resulting in a cost per bed.

DWHR assembly cost: $12,920.[8] One assembly made up of (4) units (pipes) is required.
Accessories cost: $13,500. Includes costs for pumps, storage tank, controls and other necessary equipment for non-concurrent flow applications.
Installation: $8,400. This is calculated based on the materials, equipment and labour needed to install a unit, in an existing building, as estimated from RS Means.
Maintenance: $600. DWHR is a passive technology and requires no maintenance similar to the piping systems that it is connected to. [9] However, the storage tank and pump will require yearly maintenance and the pump requires some energy to operate.
A discount rate of 10%, consistent with the TRC calculation, is applied to the yearly O&M cost, to calculate the NPV ($5991).

$274 per Bed = ($12,920 + $13,500 + $8,400 + $5,991)/ 149 Beds per Facility

Customer Payback Period (Natural Gas Only)	2.8	Years

Simple payback period, based on a natural gas price of $0.30/m^3.

$$Simple\ Payback\ Period\ = \frac{Incremental\ Cost}{Natural\ Gas\ Savings\ \times\ Natural\ Gas\ Cost - Yearly\ Cost}$$

$$= \frac{(\frac{34{,}820}{149\ Beds})(\$)}{295\ (m^3) \times 0.3\ \left(\frac{\$}{m^3}\right) - (\frac{600}{149\ Beds})\ (\$)} = 2.8\ (years)$$

References
[1] Alliance for Water Efficiency, Commercial Laundry Facilities Introduction, 2009. Available at http://www.allianceforwaterefficiency.org/commercial_laundry.aspx

[2] Ontario Hospital Association, Health System Facts and Figures- Beds Staffed and in Operation, Ontario, 2009. Available at http://www.healthsystemfacts.com

[3] Department of Veteran Affairs, Veterans Health Administration: Environmental Management Service Laundry and Linen Operations, March 2008. Available at http://www.wbdg.org/ccb/VA/VASPACE/7610-408.pdf

[4] ASHRAE Handbook 2007, HVAC Applications, Section 49- Service Water Heating

[5] Cited in the following as personal communication with City of Toronto Works Dept. VEIC, Comments on Navigant's Draft Gas Measure Characterizations, March 2009.[6] RenewABILITY Energy Inc., RenewABILITY Inc. Product Presentation, Delivered at Enermodal Engineering on November 2, 2009

[7] Value is from common industry practice, communication with Enermodal Engineering, November 2010.

[8] RenewABILITY Energy Inc.

[9] Enermodal Engineering, Development of DSM Measures and Market Information on Commercial Drain Water Heat Recovery, Rev 1., March 31, 2010

Drain Water Heat Recovery (DWHR) Units – Nursing Home, Dishwashing

Retrofit

Description/Comment
Continuous Flow Dishwasher. Savings and Costs are shown per Bed.

Efficient Equipment and Technologies Description
Drain Water Heat Recovery (DWHR) pre-heats incoming domestic cold water with the available drain water heat that would otherwise be lost. This measure applies only to DWHR systems installed with Continuous Flow Dishwashers where there is concurrent hot water flow in and drain water flow out of the DWHR system.
Base Equipment and Technologies Description
None

Decision Type	Target Market	End Use
Retrofit	Existing Nursing Home. Kitchen Dishwashing. Continuous Flow Dishwasher.	Water Heating

Codes, Standards and Regulations

None.

Resource Savings Table

	Electricity and other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3/Bed)	Electricity (KWh/Bed)	Water (L)	($/Bed)	($/Bed)
1	31	0	0	$25.33	$0.00
2	31	0	0	$0.00	$0.00
3	31	0	0	$0.00	$0.00
4	31	0	0	$0.00	$0.00
5	31	0	0	$0.00	$0.00
6	31	0	0	$0.00	$0.00
7	31	0	0	$0.00	$0.00
8	31	0	0	$0.00	$0.00
9	31	0	0	$0.00	$0.00
10	31	0	0	$0.00	$0.00
11	31	0	0	$0.00	$0.00
12	31	0	0	$0.00	$0.00
13	31	0	0	$0.00	$0.00
14	31	0	0	$0.00	$0.00

15	31	0	0	$0.00	$0.00
16	31	0	0	$0.00	$0.00
17	31	0	0	$0.00	$0.00
18	31	0	0	$0.00	$0.00
19	31	0	0	$0.00	$0.00
20	31	0	0	$0.00	$0.00
21	31	0	0	$0.00	$0.00
22	31	0	0	$0.00	$0.00
23	31	0	0	$0.00	$0.00
24	31	0	0	$0.00	$0.00
25	31	0	0	$0.00	$0.00
Total	**775**	**0**	**0**	**$25.33**	**$0.00**

Resource Savings Assumptions

Annual Natural Gas Savings	**31**	m^3/Bed

The savings associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of beds in a Nursing Home, resulting in savings per bed. See below for details.

One DWHR unit is connected to the dishwasher drain and used to preheat the water before the dishwasher water heater. A continuous flow dishwasher is used for the calculations.

The following are the characteristics used to estimate the drain water from the dishwashers:
Water Use per Meal:
= 9.1 (L/meal) * (1-70%) / (1-60%) [1]
= 6.8 (L/meal)
Average Nursing Home size: 107 beds [2]
Percentage of beds requiring meals: 75% [3]
Additional meals for staff: 20% [3]
Percentage of water use per meal for dishwashers: 80% [4]

$$Yearly\ Concurrent\ Drainwater\ Flow$$
$$= 6.8\ (L/meal) \times 3\ (meals/day) \times 365\ (days/year) \times 107\ \left(\frac{beds}{Nursing\ Home}\right) \times 75\%\ (beds\ requiring\ meals) \times 120\%\ (staff\ meals) \times 80\%$$
$$= 573{,}640\ (L/year)$$

The energy that can be recovered and therefore natural gas saved is calculated based on the following factors:
Yearly concurrent drain water flow: see above calculation
Drain water temperature for dishwasher: 77°C [1]
Domestic Cold Water Temperature: 9.33 °C [5]
DWHR unit effectiveness for noted piping configuration: 60% [6]
Standard Natural gas water heater efficiency: 78%

$$Natural\ Gas\ Saving\ (m^3) = \frac{573{,}640\ (L/year) \times 4.184\ (KJ/(Kg\ °C)) \times [77\ (°C) - 9.33\ (°C)] \times 60\ (\%)}{78\ (\%) \times 37230\ (KJ/m^3)}$$
$$= 3{,}356 (m^3/year)$$

31 m^3/yr = 3,356 m^3 / 107 Beds per facility

Annual Electricity Savings	**0**	KWh/Bed
N/A		
Annual Water Savings	**0**	L/Bed
N/A		

Other Input Assumptions

Effective Useful Life (EUL)	**25**	Years
The DWHR units have a useful life in excess of 25 years. [6]		
Base & Incremental Conservation Measure Equipment and O&M Cost	**25.33**	$/Bed
The costs associated with installing a DWHR system is calculated below. The value was calculated for an average facility and then divided by the average number of beds per facility, resulting in a cost per bed. DWHR unit cost: $1,030 [7] Installation: $1,680. This is calculated based on the materials, equipment and labour needed to install a unit, in an existing building, as estimated from RS Means. Maintenance: $0. DWHR is a passive technology and requires no maintenance similar to the piping systems that it is connected to.[8] $25.33 per Bed = ($1,030 + $1,680)/107 Beds per facility		
Customer Payback Period (Natural Gas Only)	**2.7**	Years
Simple payback period, based on a natural gas price of $0.30/m^3.		

$$Simple\ Payback\ Period\ = \frac{Incremental\ Cost}{Natural\ Gas\ Savings\ \times\ Natural\ Gas\ Cost}$$

$$= \frac{25.33(\$)}{31\ (m^3) \times 0.3\ (\$/m^3)} = 2.7\ (years)$$

References

[1] The 9.1 (L/meal) value originates from the ASHRAE Handbook 2007, HVAC Applications, Section 49 - Service Water Heating and is associated with a study from the 70's. This value was updated to reflect water use from middle-aged equipment as expected in existing buildings. Machines in existing buildings are expected to be typically 10 years old based on the equipment life of 20 years, which in-turn came from the Food Service Technology Center (FSTC) as cited in NGTC, DSM OPPORTUNITIES ASSOCIATED WITH COMMERCIAL DISHWASHERS, Final Report, April 27, 2009, pg 17.).

In order to take this into account, the 9.1 value was multiplied by one minus the 70% reduction in water use by Conveyor and Flight-Type machines since the 70's, then divided by one minus the 60% reduction in water-use of new machines vs. machines built 10 years ago. This data was gathered from a manufacturer (Suzanne Supplee - Champion Industries/BiLine) and Genevieve Bussieres from the Natural Gas Technology Centre (NGTC) quoting an NSF study

and conversations with Hobart (another manufacturer). The 70% reduction in water use value was chosen for this calculation based on the above sources (68% from Champion and 70-72% from NGTC's findings). The 60% reduction value was chosen based on the same sources (61% from Champion and 58% from NGTC's findings).

[2] American Health Care Association, Trends in Nursing Facility Characteristics, December 2009. Available at http://www.ahcancal.org/Pages/Default.aspx

[3] Grand River Hospital - Diet Office of the Nutrition/Food Service Department.

[4] Wexiodisk, Rack Conveyor Dishwasher, 2006. Available at www.wexiodisk.com

[5] Cited in the following as personal communication with City of Toronto Works Dept. VEIC, Comments on Navigant's Draft Gas Measure Characterizations, March 2009.

[6] RenewABILITY Energy Inc., RenewABILITY Inc. Product Presentation, Delivered at Enermodal Engineering on November 2, 2009

[7] RenewABILITY Energy Inc.

[8] Enermodal Engineering, Development of DSM Measures and Market Information on Commercial Drain Water Heat Recovery, Rev 1., March 31, 2010

ENERGY STAR DISHWASHERS

Commercial – New/Existing

Efficient Technology & Equipment Description
Energy Star versions of (6) different types of Commercial Dishwashers: Undercounter Type – High Temperature (HT) Undercounter Type – Low Temperature (LT) Stationary Rack, (Door type, or Single rack) - HT Stationary Rack, (Door type, or Single rack) - LT Rack Conveyor, Single (Tank) – HT Rack Conveyor, Multi (Tank) - HT
Base Technology & Equipment Description
Non-Energy Star Dishwashers

Resource Savings Assumptions

Natural Gas	**See below**
Energy Savings were based on the results of NGTC study and savings calculator. NGTC racks or loads/day data for stationary Rack dishwashers was updated using UG territory data. The remaining load data came from FSTC & Energy Star. NGTC booster heater fuel type was updated to electric, due to popularity in Ontario. The idle energy rate & water use per rack values were adjusted by NGTC to represent an Energy Star dishwasher model that is not of average E-Star efficiency and not that just meets the minimum, but halfway in-between (25th percentile E-Star model, based on efficiency). **Assumptions[1]:** DW supply water temperature: 140°F (60°C) Temperature increase for building water heating: 90°F (50°C)[2] Natural gas water heater annual efficiency (recovery rate): 78%[3] Electric booster water heater efficiency: 96%[4] Wash water circulation temperature differential: 20°F (11°C)[5]. The 25th percentile E-Star models (in terms of efficiency) are sold more often than the average E-Star model.[6] Undercounter - HT **801 m3/yr** Undercounter - LT **326 m3/yr** Stationary Rack - HT **619 m3/yr** Stationary Rack - LT **841 m3/yr**	

[1] NGTC, DSM Opportunities Associated with Commercial Dishwashers, Final Report, April 27, 2009, Pg 13 and calculator, 100201_DSM_analysis_final - PK.xlsx.
[2] DHW DW supply – Water city average = 140°F-50°F = 90°F (60°C-10°C = 50°C).
[3] GAMA
[4] Minimum EF for a 5 gallon booster; 98% of boosters are electric (source: Steve Garvin, UG)
[5] Phone conversation with Joel Dipp from Hobart, worst case.
[6] As discussed with the EAC & UG during conversation, estimated, no data, April 2010.

Rack Conveyor Single – HT	**2,203 m3/yr**
Rack Conveyor Multi - HT	**3,708 m3/yr**
Electricity	**See below**

Electrical savings based on idle energy, pump energy, conveyor energy (where applicable), electric booster heater energy (for HT models). The assumptions above also apply.[7]

Undercounter - HT	**3,754 kWh/yr**
Undercounter - LT	**559 kWh/yr**
Stationary Rack - HT	**3,553 kWh/yr**
Stationary Rack - LT	**855 kWh/yr**
Rack Conveyor Single – HT	**9,811 kWh/yr**
Rack Conveyor Multi - HT	**15,822 kWh/yr**
Water	**See below**

Water savings is based on Energy Star Criteria, LBNL data, manufacturer wash tank capacity data, and associated differences in water use in wash & rinse cycles.[8]

Undercounter - HT	**112,795 L/yr**
Undercounter - LT	**45,891 L/yr**
Stationary Rack - HT	**87,119 L/yr**
Stationary Rack - LT	**118,369 L/yr**
Rack Conveyor Single – HT	**310,271 L/yr**
Rack Conveyor Multi - HT	**522,192 L/yr**

Other Input Assumptions

Equipment Life	**See below**

The equipment lifetime came from FSTC (Food Service Technology Centre) who contributed to the development of the Energy Star US calculator.[9],[10] No lifetime distinction was identified relative to the sanitation method (high or low temperature) or to the efficiency (Energy Star qualified or not) of the dishwashers.

Undercounter - HT	**10 yrs**
Undercounter - LT	**10 yrs**
Stationary Rack - HT	**15 yrs**
Stationary Rack - LT	**15 yrs**

[7] NGTC, DSM Opportunities Associated with Commercial Dishwashers, Final Report, April 27, 2009, Pg 13 and calculator, 100201_DSM_analysis_final - PK.xlsx.
[8] NGTC, DSM Opportunities Associated with Commercial Dishwashers, Final Report, April 27, 2009, Pg 14 and calculator, 100201_DSM_analysis_final - PK.xlsx.
[9] NGTC, DSM Opportunities Associated with Commercial Dishwashers, Final Report, April 27, 2009, Pg 17
[10] US Energy Star. Energy Star Program Requirements for Commercial Dishwashers. [On line]. September 2008. http://www.energystar.gov/ia/partners/product_specs/eligibility/comm_dishwashers_elig.pdf.

Rack Conveyor Single – HT **20 yrs** Rack Conveyor Multi - HT **20 yrs**	
Incremental Cost	**See below**
According to DW manufacturers and their sales representatives there is no distinguishable difference in installation costs between the base case & upgrade cases, therefore they were left out. NGTC updated their pricing to reflect the 25th percentile (in terms of efficiency) E-Star models because it was presumed to be sold more often than the average E-Star model.[11] List pricing was used because this analysis couldn't be done using the report's original pricing source because not enough information (pricing according to exact efficiency wasn't available). List prices for Energy Star (ES) and Non-ES models were obtained from manufacturers' lists when available and from online commercial dishwasher vendors such as dishwasherworld.com, greatdishwashers.com, restaurantequipment.net, foodservicewarehouse.com and retrevo.com. Undercounter - HT (-) **$13** Undercounter - LT (-) **$13** Stationary Rack - HT (-) **$350** Stationary Rack - LT (-) **$350** Rack Conveyor Single – HT **$2,375** Rack Conveyor Multi - HT **$288**	
Free Ridership	**See below**
Free Ridership is estimated using market share for Energy Star Dishwashers in UG territory.[12] Undercounter - HT **40%** Undercounter - LT **40%** Stationary Rack - HT **20%** Stationary Rack - LT **20%** Rack Conveyor Single – HT **27%** Rack Conveyor Multi - HT **27%**	

[51] NGTC, DSM Opportunities Associated with Commercial Dishwashers, Final Report, April 27, 2009, Pg 13 and calculator, 100201_DSM_analysis_final - PK.xlsx.
[52] DHW DW supply – Water city average = 140°F-50°F = 90°F (60°C-10°C = 50°C).
[53] GAMA
[54] Minimum EF for a 5 gallon booster; 98% of boosters are electric (source: Steve Garvin, UG)
[55] Phone conversation with Joel Dipp from Hobart, worst case.
[56] As discussed with the EAC & UG during conversation, estimated, no data, April 2010.

[11] As agreed upon with the EAC & UG, estimated, no data, April 9, 2010.
[12] NGTC, DSM Opportunities Associated with Commercial Dishwashers, Final Report, April 27, 2009, Pg 11

[57] NGTC, DSM Opportunities Associated with Commercial Dishwashers, Final Report, April 27, 2009, Pg 13 and calculator, 100201_DSM_analysis_final - PK.xlsx.
[58] NGTC, DSM Opportunities Associated with Commercial Dishwashers, Final Report, April 27, 2009, Pg 14 and calculator, 100201_DSM_analysis_final - PK.xlsx.
[59] NGTC, DSM Opportunities Associated with Commercial Dishwashers, Final Report, April 27, 2009, Pg 17
[60] US Energy Star. Energy Star Program Requirements for Commercial Dishwashers. [On line]. September 2008. http://www.energystar.gov/ia/partners/product_specs/eligibility/comm_dishwashers_elig.pdf.
[61] As agreed upon with the EAC & UG, estimated, no data, April 9, 2010.
[62] NGTC, DSM Opportunities Associated with Commercial Dishwashers, Final Report, April 27, 2009, Pg

HIGH EFFICIENCY BOILERS UNDER 300 MBH

Small Commercial – New/Existing

Efficient Technology & Equipment Description
High Efficiency non-condensing boilers having annual fuel utilization efficiency (AFUE) of 85% or greater. Boiler input size is under 300,000 Btu/hr. Application is for seasonal or non-seasonal use. MBH is defined throughout this document as 1,000 Btu/hr.
Base Technology & Equipment Description
Non-condensing boiler having an AFUE of 80% for either seasonal or non-seasonal use. Boiler input size is under 300,000 Btu/hr.

Resource Savings Assumptions

Natural Gas	**<u>Seasonal</u>** **0.00665 m^3 /(Btu/hr Boiler Input)** **<u>Non-Seasonal</u>** **Boiler Input Under 100 MBH = 0.02430 m^3 /(Btu/hr Boiler Input)** **Boiler Input 100 To Under 200 MBH = 0.01491 m^3 /(Btu/hr)** **Boiler Input 200 To Under 300 MBH = 0.01115 m^3 /(Btu/hr)**

<u>Estimation Based on Agviro Study for Enbridge</u>

- Based on Agviro's report[1], the energy analysis compares use of a high efficiency non-condensing boiler having an AFUE of 87.5% versus a base case non-condensing boiler having an AFUE of 80%.
- The normalized gas use for a seasonal base case boiler is determined by the relationship:

  $$Normalized\,Gas\,Use = 77.575 \times BoilerIP$$

  where:

  BoilerIP = seasonal boiler input size (MBH)
  Normalized Gas Use = normalized annual seasonal gas use (m3/yr)

- The gas savings for a non-seasonal base case boiler is determined by the relationship:

  $$NonSeasonal\,Gas\,Use = 36.282 \times BoilerIP + 9256.9$$

  where:

  BoilerIP = seasonal boiler input size (MBH)
  Non Seasonal Gas Use = annual non-seasonal gas use (m3/yr)

- The gas savings of the condensing versus the base case boiler is determined by the relationship:

[1] Prescriptive Savings Analysis – Condensing Boilers Under 300MBH, Agviro Inc., Jan 17, 2011

$$GasSavings = GasUse \times (1 - \frac{\%Eff_{BC}}{\%Eff_{CE}})$$

where:

GasUse = seasonal or non-seasonal gas use (m3)
$\%Eff_{BC}$ = Efficiency of the Base Case boiler
[seasonal = 80%; non-seasonal=66.2%]
$\%Eff_{CE}$ = Efficiency of the Condensing boiler
[seasonal = 87.5%; non-seasonal=78.08%]
GasSavings = annual gas savings (m3/yr)

- On a per Btu/hr boiler input basis, the natural gas savings is:
  - seasonal boiler = 0.00665 m^3 / (Btu/hr)
  - non-seasonal boiler =
    - Boiler Input Under 100 MBH = 0.02430 m^3 /(Btu/hr Boiler Input)
    - Boiler Input 100 To Under 200 MBH = 0.01491 m^3 /(Btu/hr)
    - Boiler Input 200 To Under 300 MBH = 0.01115 m^3 /(Btu/hr)

Electricity	**0 kWh**

Water	**0 L**

Other Input Assumptions

Equipment Life	**25 yrs**

-

Incremental Cost

<u>Existing Construction</u>

Boiler Input (MBH)	Incremental Cost ($)
Under 100	**$1,808**
100 To Under 200	**$2,114**
200 To Under 300	**$1,958**

<u>New Construction</u>

Boiler Input (MBH)	Incremental Cost ($)
Under 100	**$1,238**
100 To Under 200	**$1,544**
200 To Under 300	**$1,388**

Incremental costs account for differences in venting, controls and labour.

<u>Incremental Cost – Existing Construction</u>

- Boiler Input Under 100 MBH = $1,808
- Boiler Input 100 To Under 200 MBH = $2,114
- Boiler Input 200 To Under 300 MBH = $1,958

Incremental Cost – New Construction

- Boiler Input Under 100 MBH = $1,238
- Boiler Input 100 To Under 200 MBH = $1,544
- Boiler Input 200 To Under 300 MBH = $1,388

PRE-RINSE SPRAY NOZZLE (0.64 GPM)

Commercial Existing / New Market

Efficient Technology & Equipment Description
Low-flow pre-rinse spray nozzle/valve (0.64 GPM)
Base Technology & Equipment Description
Standard pre-rinse spray nozzle/valve (3.0 GPM)

Resource Savings Assumptions

Natural Gas	**See below m^3**

Market Segment	Natural Gas (m^3/yr
Full Dining Establishments	1,286
Limited Service Establishments	339
Other Establishments	318

A field study was undertaken at 37 sites across 4 regions in Union Gas territory. Measurements of water pressure, incoming and leaving (at both burner On and Off setpoints) water temperature at the water heater and supplied to the pre-rinse spray valve, details of the make, model and type of water heater, and type of food service establishment, were collected at each site.

Flow rate vs. pressure curves for high-flow and nominal 0.64 USgpm pre-rinse spray valves (PRSV) were developed from the Veritec studies in Waterloo[1] and Calgary[2]. An average flow rate vs pressure curve for high-flow PRSVs was developed from the Veritec Waterloo study.

Water savings were evaluated for each region based on the difference between the flow rates of the high-flow and low-flow PRSV at the average measured water pressure, and the average usage of the PRSV for each of 3 food service establishmentc types from the Veritec studies in Waterloo and Calgary.

Natural gas savings were determined using the US-DOE WHAM[3] model to establish water heater efficiency. Inputs to the model from site measurements included the average cold water and hot water setpoint temperatures for each region. Additional inputs to the model included water heater energy factor and rated water heater input (both average for the region), ambient air temperature (assumed at 70°F), and average daily volume of hot water. This last item was determined from a combination of research undertaken by FSTC[4], and ASHRAE[5] recommendations, for each food service establishment type. The proportion of hot water delivered to the PRSV was determined from the average measured mixed water temperature for each region. Operating times are not
expected to be different between 1.24 & 0.64 (Bricor model B064) USgpm models based on cleanability times of 20-21 seconds according to the FTSC[6].
Resource Savings are not dependent on Decision Type, i.e., New or Existing facilities

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1 "Region of Waterloo – Pre-Rinse Spray Valve Pilot Study – Final Report", Veritec Consulting Inc., January 2005
2 "City of Calgary" – Pre-Rinse Spray Valve Pilot Study – Final Report", Veritec Consulting Inc., December 2005.
3 Appendix D-2. Water Heater Analysis Model. Water Heater Rulemaking Technical Support Documents. http://www1.eere.energy.gov/buildings/appliance_standards/residential/waterheat_0300_r.html
4 Charles Wallace and Don Fisher Energy Efficiency Potential of Gas-Fired Commercial Hot Water Heating Systems in Restaurants. FSTC April 2007
5 ASHRAE Handbook 2007HVAC Applications. Chapter 49
6 pg 32 & 37 "Deemed Savings for (Low Flow) Pre-Rinse Spray Nozzles" by Energy Profiles, January 30, 2009.

Electricity	**0 kWh**

Water	**See below L**

Market Segment	Water (L)[6]
Full Dining Establishments	252,000
Limited Service Establishments	66,400
Other Establishments	62,200

Assumptions and inputs:

- Water savings were evaluated for 3 food service establishment types: Full Service Restaurants, Limited Service Restaurants, and Other
- The PRSV water usage was based on the 2 Veritec studies, and incorporated the measured differences in usage time for the high-flow and low-flow PRSVs.

Resource Savings are not dependent on Decision Type, i.e., New or Existing facilities

Other Input Assumptions

Equipment Life	**5 years**

As per EB 2008-0346 Decision Commercial Existing facilities.

Incremental Cost (Cust. / Contr. Install)	**$150**

$88 = ($50/pc* + $1/pc* shipping USD) x 1.28901** exchange rate + $22 installation***

*estimated by Bricor, March 2, 2009

**Exchange rate from March 2, 2009 - http://www.xe.com/ucc/convert.cgi

***estimated installation from Seattle Utilities ($21-23/pc), based on conversation with Bricor, March 2, 2009

Free Ridership	**0 %**

Basis: Relatively new product probably only aware of one manufacturer (Bricor).

Pre-Rinse Spray Nozzle (0.64 GPM)

Commercial – Existing Market

Efficient Equipment and Technologies Description
Low-flow pre-rinse spray nozzle/valve (0.64 GPM) Due to the variability in energy savings resulting from variability in daily water use, resource savings were calculated for three types of commercial enterprise using this technology[1]: Scenario **A**: Full service restaurant Scenario **B:** Limited service (fast food) restaurant Scenario **C:** Other

Base Equipment and Technologies Description
Less efficient pre-rinse spray nozzle/valve (1.6 GPM)

Decision Type	Target Market(s)	End Use
Retrofit	Commercial (existing)	Water heating

Codes, Standards, and Regulations

N/A

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	**A:** 457 **B:** 90 **C:** 109	0	**A:** 97,292 **B:** 19,197 **C:** 23,166	150	0
2	**A:** 457 **B:** 90 **C:** 109	0	**A:** 97,292 **B:** 19,197 **C:** 23,166	0	0
3	**A:** 457 **B:** 90 **C:** 109	0	**A:** 97,292 **B:** 19,197 **C:** 23,166	0	0
4	**A:** 457 **B:** 90 **C:** 109	0	**A:** 97,292 **B:** 19,197 **C:** 23,166	0	0
5	**A:** 457 **B:** 90 **C:** 109	0	**A:** 97,292 **B:** 19,197 **C:** 23,166	0	0
TOTALS	**A:** 2,284 **B:** 451 **C:** 544	**0**	**A:** 486,462 **B:** 95,987 **C:** 115,829	**150**	**0**

[1] These bins are chosen based on empirical research conducted by Energy Profiles Ltd on behalf of Union Gas Energy Profiles Ltd, *Deemed Savings for (Low Flow) Pre-Rinse Spray Nozzles*, January 2009

Resource Savings Assumptions

Annual Natural Gas Savings	**A:** 457 m^3 **B:** 90 m^3 **C:** 109 m^3

Assumptions and inputs:

- Average water inlet temperature: 14.5 ^oC (58 ^oF)[2]
- Average food service water heater set point temperature: 63 ^oC (145 ^oF)[3]
- Water heater thermal efficiency: 0.78[4]
- Percentage of water used that is hot: 69%[5]

Annual gas savings calculated as follows:

$$Savings = Ws * Phot * 8.33 * (T_{out} - T_{in}) * \frac{1}{Eff} * 10^{-6} * 27.8$$

Where:

Ws = Water savings (gallons)
Phot = Percentage of water used that is hot
T_{out} = Water heater set point temperature (^oF)
T_{in} = Water inlet temperature (^oF)
Eff = Water heater thermal efficiency
8.33 = Energy content of water (Btu/gallon/^oF)
10^{-6} = Factor to convert Btu to MMBtu
27.8 = Factor to convert MMBtu to m^3

Gas savings were determined to be 60% over base equipment:

$$Percent\ Savings = \frac{(G_{base} - G_{eff})}{G_{base}}$$

Where:

Full service restaurant:
G_{eff} = Annual natural gas use with efficient equipment, 305 m^3
G_{base} = Annual natural gas use with base equipment, 761 m^3

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[2] A simple average of Toronto inlet temperature, cited in the following as personal communication with City of Toronto Works Dept. VEIC, *Comments on Navigant's Draft Gas Measure Characterizations*, March 2009, and the average inlet water temperatures found in four jurisdictions examined as part of the following study: Energy Profiles Ltd, *Deemed Savings for (Low Flow) Pre-Rinse Spray Nozzles*, January 2009

[3] Average of temperatures found in a survey of restaurants in four Ontario municipalities. Energy Profiles Ltd, *Deemed Savings for (Low Flow) Pre-Rinse Spray Nozzles*, January 2009
[4] Minimum thermal efficiency for compliance with ASHRAE 90.1 standard.
[5] Average of ratio found in a survey of restaurants in four Ontario municipalities. Energy Profiles Ltd, *Deemed Savings for (Low Flow) Pre-Rinse Spray Nozzles*, January 2009

Limited service restaurant:
G_{eff} = Annual natural gas use with efficient equipment, 60 m^3
G_{base} = Annual natural gas use with base equipment, 150 m^3

Other:
G_{eff} = Annual natural gas use with efficient equipment, 73 m^3
G_{base} = Annual natural gas use with base equipment, 181 m^3

Annual Electricity Savings	**0 kWh**
N/A	
Annual Water Savings	**A:** 97,292 L **B:** 19,197 L **C:** 23,166 L

Assumptions and inputs:

- The study by Energy Profiles Ltd cited above measured average daily use for each facility examined before and after a 3.0 GPM nozzle was replaced with a 1.24 GPM nozzle. The difference in average usage time by facility, before and after replacement was tested by Navigant Consulting and found to be not statistically significant. Additionally, the same study reports that its findings suggest no difference in the duration of use between a 0.64 GPM nozzle and a 3.0 GPM nozzle. Given these results, Navigant Consulting has assumed that duration of use will be identical before and after replacement.
- From the Energy Profiles Ltd. study cited above, the following average durations of use were calculated:

  Full-service restaurant: 1.26 hours per day.
  Limited-service restaurant: 0.24 hours per day
  Other: 0.33 hours per day
- The average numbers of days of operation per year for each restaurant type were drawn from the Energy Profiles Ltd. report. They are:

  Full-service restaurant: 355 days per year.
  Limited-service restaurant: 365 days per year.
  Other: 320 days per year.

Annual water savings calculated as follows:

$$Savings = \left(Fl_{base} - Fl_{eff}\right) * 60 * Hr * Days$$

Where:

Fl_{base} = Flow rate of base equipment (GPM)
Fl_{eff} = Flow rate of efficient equipment (GPM)
60 = Minutes per hour
Hr = Hours used per day
Days = Days per year

Water savings were determined to be 60% over base equipment:

$$Percent\ Savings = \frac{(W_{base} - W_{eff})}{W_{base}}$$

Where:

Full service restaurant:

W_{eff} = Annual water consumed with efficient equipment, 64,862 litres

W_{base} = Annual water consumed by showers with base equipment: 162,154 litres

Limited service restaurant:

W_{eff} = Annual water consumed with efficient equipment, 12,798 litres

W_{base} = Annual water consumed by showers with base equipment: 31,996 litres

Other:

W_{eff} = Annual water consumed with efficient equipment, 15,444 litres

W_{base} = Annual water consumed by showers with base equipment: 38,610 litres

Other Input Assumptions

Effective Useful Life (EUL)	**5 Years**
Studies conducted for the City of Calgary[6], the U.S. DOE's FEMP[7] and by Puget Sound Energy[8] all give EUL for this measure as five years.	
Base & Incremental Conservation Measure Equipment and O&M Costs	**150 $**
Equipment cost: $100 (Enbridge bulk price). Installation cost: $50 (Contracted price with third-party installer).	
Free Ridership	**0%**
Basis: Relatively new product probably only aware of one manufacturer (Bricor).	

68 These bins are chosen based on empirical research conducted by Energy Profiles Ltd on behalf of Union Gas Energy Profiles Ltd, *Deemed Savings for (Low Flow) Pre-Rinse Spray Nozzles*, January 2009

69 1 A simple average of Toronto inlet temperature, cited in the following as personal communication with City of Toronto Works Dept.
VEIC, *Comments on Navigant's Draft Gas Measure Characterizations*, March 2009, and the average inlet water temperatures found in four jurisdictions examined as part of the following study: Energy Profiles Ltd, *Deemed Savings for (Low Flow) Pre-Rinse Spray Nozzles*, January 2009

170 Average of temperatures found in a survey of restaurants in four Ontario municipalities.

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[6] Ibid.

[7] U.S. DOE, Federal Energy Management Program, *How to Buy a Low-Flow Pre-Rinse Spray Valve* http://www1.eere.energy.gov/femp/pdfs/prerinsenozzle.pdf

[8] Quantec *Comprehensive Assessment of Demand-Side Resource Potentials (2008-2027)* Prepared for Puget Sound Energy

Energy Profiles Ltd, *Deemed Savings for (Low Flow) Pre-Rinse Spray Nozzles*, January 2009

[171] Minimum thermal efficiency for compliance with ASHRAE 90.1 standard.

[72] [1] Average of ratio found in a survey of restaurants in four Ontario municipalities.
Energy Profiles Ltd, *Deemed Savings for (Low Flow) Pre-Rinse Spray Nozzles*, January 2009

[73] [1] Ibid.

[74] [1] U.S. DOE, Federal Energy Management Program, *How to Buy a Low-Flow Pre-Rinse Spray Valve* http://www1.eere.energy.gov/femp/pdfs/prerinsenozzle.pdf

[75] [1] Quantec *Comprehensive Assessment of Demand-Side Resource Potentials (2008-2027)* Prepared for Puget Sound Energy

HIGHER EFFICIENCY BOILERS – DOMESTIC WATER HEATING

Existing and New Commercial and Multi- Residential

Efficient Technology & Equipment Description
Hydronic Boilers for water heating (Non Seasonal)
Base Technology & Equipment Description
80% Combustion Efficiency Domestic Water Heating Boiler

Resource Savings Assumptions

Natural Gas (Updated)

Boiler Size	Domestic Water Heating (Non Seasonal) M3 Savings by Combustion Efficiency 83-84%	85-88%
300 MBH	1,075	1,766
600 MBH	1,777	2,290
1,000 MBH	3,136	5,155
1,500 MBH	4,317	7,095

Source: Prescriptive Commercial Boiler Program – Prescriptive Savings Analysis – Agviro Report Sept 10, 2008.

An iterative approach was used to determine the annual savings in the commercial sector. The following steps were taken:
a. The Rate 6 accounts were subdivided into bins of annual gas use. This provided the annual average gas use, number of accounts, seasonal, non-seasonal and total gas use.
b. The seasonal portion of the annual gas use was normalized to 30 year weather data. This normalized gas use was correlated to a seasonal boiler size required for gas consumption.
c. Categories of boiler sizes were selected to provide a suitable range of boilers available within the sector.
d. The Rate 6 accounts were subdivided using the normalized average seasonal gas use for the respective categories of boilers selected. This provided the annual average gas use, number of accounts, and total gas use per seasonal boiler size category.
e. Seasonal annual gas use normalization of the boiler size category accounts was completed.
f. Annual seasonal efficiency of the boiler size categories for each of the combustion efficiency ranges was determined.
g. Boiler costs for the boiler size categories was compiled.
h. A TRC analysis was completed for each of the boiler size categories.
i. A similar approached was used for the non-seasonal gas use with the exception of normalizing the data.

Electricity (Updated)	**kWh**

Water	**L**

Other Input Assumptions

Equipment Life	**25**	**years**
As per EB 2008-0384 & 0385		
Incremental Cost (Contr. Install)	**Boiler Size** **300 MBH** **600 MBH** **1,000 MBH** **1,500 MBH**	**Domestic Water Heating (Non Seasonal) Incremental Cost by Combustion Efficiency** **83-84% 85-88%** **$3,900 $ 4,500** **$5,800 $ 6,000** **$7,400 $10,300** **$5,900 $ 7,400**
Source: Prescriptive Commercial Boiler Program – Prescriptive Savings Analysis – Agviro Report Sept 10, 2008.		
Free Ridership	**Enbridge** **Small Commercial 10%** **Large Commercial 12%** **Multi-Family 20%**	
As per EB 2008-0384 – 0385		

TANKLESS WATER HEATER

Commercial – Existing/New Build

Efficient Technology & Equipment Description
Tankless Water Heater (84% thermal efficiency (77% adjusted thermal efficiency), where approximately 50-150 USG/day will be used.
Base Technology & Equipment Description
Conventional storage tank gas water heater (thermal efficiency[i]=80%), 91 gallons.

Resource Savings Assumptions

Natural Gas	**154 m^3**
As approved in EB-2008-0346, Tankless Water Heater – Commercial, Decision Type: New. Resource savings are not dependent on Decision Type.	
Electricity	**n/a kWh**
Water	**n/a L**

Other Input Assumptions

Equipment Life	**18 years**
As approved in EB-2008-0346, Tankless Water Heater – Commercial, Decision Type: New. Equipment life is not dependent on Decision Type	
Incremental Cost (Cust. / Contr. Install)	**$-1,102**
As approved by EB-2008-0346, Tankless Water Heater – Commercial, Decision Type: New. Incremental Cost is not dependent on Decision Type	
Free Ridership	**2 %**
Free-ridership rate as per EB-2008-0384 and 0385	

[i] Although the required minimum thermal efficiency to be in compliance with ASHRAE 90.1 is 78%, http://www.energycodes.gov/comcheck/pdfs/404text.pdf, only an very small percentage of commercial gas water heaters listed in the GAMA *Consumer's Directory of Certified Efficiency Ratings* had a thermal efficiency of less than 80%. http://www.neo.ne.gov/neq_online/july2006/commgaswtrhtr.pdf

Multi-Family Water Heating

CEE Tier 2 Front-Loading Clothes Washer

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description
CEE Tier 2 high efficiency front load washers for application in the Multi-Family sector (MEF[1]=2.20 , WF[2]=5.1, tub size = 2.8 ft^3)
Base Equipment and Technologies Description
Conventional top loading vertical axis washers (MEF = 1.26, WF=9.5, tub size = 2.8 ft^3)

Decision Type	Target Market(s)	End Use
New/Replacement	Multi-Family	Water heating

Codes, Standards, and Regulations

NRCan Federal Energy Efficiency Regulations require:

- Top loading washers are required to have a minimum MEF of 1.26 and a maximum tub size of 3.5 cubic feet.
- Front loading washers are required to have a minimum MEF of 1.26 and a maximum tub size of 4 cubic feet.

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	117	396	58,121	$1,450	$850
2	117	396	58,121	0	0
3	117	396	58,121	0	0
4	117	396	58,121	0	0
5	117	396	58,121	0	0
6	117	396	58,121	0	0
7	117	396	58,121	0	0
8	117	396	58,121	0	0
9	117	396	58,121	0	0
10	117	396	58,121	0	0
11	117	396	58,121	0	0
TOTALS	**1,287**	**4,356**	**639,331**	$1,450	$850

[1] Modified Energy Factor.
[2] Water Factor: the number of gallons per load cycle per cubic foot that the clothes washer uses. The lower the water factor, the more efficient the washer is.

Resource Savings Assumptions

Annual Natural Gas Savings	117 m^3

Assumptions and inputs:

- Percentage of water used by base equipment which is hot water: 17%.
- Percentage of water used by efficient equipment which is hot water: 10%[3]
- Average water inlet temperature: 9.33 ^oC (48.8 ^oF)[4]
- Average water heater set point temperature: 54 ^oC (130 ^oF)[5]
- Water heater thermal efficiency: 0.78[6]
- Gas use per cycle[7] for commercial gas dryer with base equipment: 0.138 m^3
- Gas use per cycle for commercial gas dryer with CEE Tier 2 clothes washer: 0.96 m^3
- Gas dryer penetration in Ontario Multi-Family market: 25.5%[8]
- Annual gas savings from reduced dryer use: 13 m^3
- Annual gas savings from reduced hot water use: 103 m^3

Annual gas savings calculated as follows:

$$Savings = \left[\left(W_{base} * Hot_{base} - W_{eff} * Hot_{eff}\right) * 8.33 * \frac{1}{Eff} * \left(T_{out} - T_{in}\right) + \left(Dr_{base} - Dr_{eff}\right) * Pene \right] * 10^{-6} * 27.8$$

Where:

W_{base} = Annual water use with base equipment (gallons)
W_{eff} = Annual water use with efficient equipment (gallons)
Hot_{base} = Percentage of water used that's hot with base equipment
Hot_{eff} = Percentage of water used that's hot with efficient equipment
8.33 = Energy content of water (Btu/gallon/^oF)
Eff = Eff = Water heater thermal efficiency
T_{out} = Water heater set point temperature (^oF)
T_{in} = Water inlet temperature (^oF)
Dr_{base} = Annual dryer gas use with base equipment (Btu)
Dr_{eff} = Annual dryer gas use with efficient equipment (Btu)
Pene = Penetration rate of natural gas powered clothes dryers in Ontario
10^{-6} = Factor to convert Btu to MMBtu
27.8 = Factor to convert MMBtu to m^3

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[3] Base equipment uses 4.4 gallons of hot water per cycle, efficient equipment uses 1.4 gallons of hot water per cycle. U.S. DOE Federal Energy Management Program, Life-Cycle and Cost and Payback Period spreadsheet, http://www1.eere.energy.gov/buildings/appliance_standards/commercial/clothes_washers.html

[4] Chinnery, Glen. *Policy Recommendations for the HERS Community to Consider regarding HERS point credit for Waste Water Heat Recovery Devices,*EPA, Energy Star for homes, March 2004 http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/Waste_Water_Heat_Recovery_Guidelines.pdf

[5] As suggested by NRCan: http://oee.nrcan.gc.ca/residential/personal/new-homes/water-conservation.cfm?attr=4

[6] Minimum thermal efficiency for compliance with ASHRAE 90.1 standard.

[7] U.S. DOE Federal Energy Management Program, National Energy Savings and Shipments spreadsheet http://www1.eere.energy.gov/buildings/appliance_standards/commercial/clothes_washers.html

[8] Average residential penetration rate of gas dryers in Union and Enbridge territories. The commercial/Multi-Family clothes dryers is likely to be slightly higher. Enbridge Gas Distribution, *Enbridge Gas Distribution to the Ontario Power Authority in the matter of the province's energy supply mix,* August 26, 2005. http://www.energy.gov.on.ca/opareport/Part%205%20-%20Submissions%20and%20Presentations/5.1%20Written%20Submissions%20to%20the%20Supply%20Mix%20Project/Enbridge_Gas_Distribution_Supply_Mix_Submission_Aug_26_2005.pdf

Gas savings were determined to be 66% over base equipment.

$$PercentSavings = \frac{(G_{base} - G_{eff})}{G_{base}}$$

Where:

G_{eff} = Annual natural gas use with efficient equipment, 73 m^3
G_{base} = Annual natural gas use with base equipment, 176 m^3

Annual Electricity Savings	**396 kWh**

Assumptions and inputs:

- Water heated by natural gas (see above).
- Washer electricity use per cycle, base equipment: 0.13 kWh[9].
- Washer electricity use per cycle, efficient equipment: 0.11 kWh.
- Dryer electricity use per cycle, base equipment: 1.3 kWh.
- Dryer electricity use per cycle, efficient equipment: 0.9 kWh.
- Average number of cycles per year for clothes washer serving Multi-Family: 1,246 cycles[10].

Annual electricity savings calculated as follows:

$$Savings = [(Wa_{base} - Wa_{eff}) + (Dr_{base} - Dr_{eff}) * (1 - Pene)] * Cyc$$

Where:

Wa_{base} = Washer electricity use per cycle, base equipment (kWh)
Wa_{eff} = Washer electricity use per cycle, efficient equipment (kWh)
Dr_{base} = Dryer electricity use per cycle, base equipment (kWh)
Dr_{eff} = Dry electricity use per cycle, efficient equipment (kWh)
Pene = Penetration rate of natural gas powered clothes dryers in Ontario
Cyc = Average number of cycles per year machine is used

Electricity savings were determined to be 29% over base equipment:

$$Percent\ Savings = \frac{(Elec_{base} - Elec_{new})}{Elec_{base}}$$

Where:

$Elec_{eff}$ = Annual natural gas use with efficient equipment, 973 kWh
$Elec_{base}$ = Annual natural gas use with base equipment, 1,369 kWh

Annual Water Savings	**58,121 L**

Assumptions and inputs:

[9] U.S. DOE Federal Energy Management Program, Life-Cycle and Cost and Payback Period spreadsheet, http://www1.eere.energy.gov/buildings/appliance_standards/commercial/clothes_washers.html
[10] U.S. DOE Federal Energy Management Program, National Energy Savings and Shipments spreadsheet http://www1.eere.energy.gov/buildings/appliance_standards/commercial/clothes_washers.html

- Water use per cycle, base equipment: 101 litres (26.6 gallons).
- Water use per cycle, new technology: 54 litres (14.3 gallons).
- Average number of cycles per year for clothes washer serving Multi-Family: 1,246 cycles[11]

Annual water savings calculated as follows:

$$Savings = (W_{base} - W_{eff}) * Cyc$$

Where:

W_{base} = Annual water use with base equipment (gallons or litres)
W_{eff} = Annual water use with efficient equipment (gallons or litres)
Cyc = Average number of cycles per year machine is used

Water savings were determined to be 46% over base measure:

$$PercentSavings = \frac{(W_{base} - W_{eff})}{W_{base}}$$

Where:

W_{eff} = Annual water consumed with efficient equipment, 67,368 litres (17,793 gallons).
W_{base}= Annual water consumed by showers with base equipment: 125,489 litres (33,144 gallons).

Other Input Assumptions

Effective Useful Life (EUL)	11 Years
The U.S. DOE's Federal Energy Management Program has determined that commercial/Multi-Family clothes washers have an average EUL of 11.25 years[12]. Navigant Consulting recommends adopting an EUL of 11 years.	
Base & Incremental Conservation Measure Equipment and O&M Costs	**600 $**
Incremental cost based on prices offered online by a local retailer[13] and that given by Enbridge.	
Customer Payback Period (Natural Gas Only)[14]	**10 Years**
Using a 5-year average commodity cost (avoided cost)[15] of \$0.38 / m^3 and an average commercial distribution cost[16] of \$0.12 / m^3, the payback period for natural gas savings is determined to be 10 years, based on the following:	

[11] Ibid.
[12] Ibid.
[13] Base measure (3.5 cu/ft top loader, GE): $850
www.homedepot.ca. Assuming the base equipment cost/ efficient equipment cost ratio of the two 3.5 cu/ft washers is equivalent to that of two 2.8 cu/ft washers.
[14] Customer payback period has been calculated using natural gas savings only. Where applicable, payback period is expected to decrease when electricity and/or water savings are included.
[15] 2009 Avoided gas cost provided by Union Gas. 5 year average avoided gas cost determined by taking average for baseload and weather sensitive avoided gas cost.
[16] Average distribution cost taken calculated from both Union Gas website (http://www.uniongas.com/residential/rates/) and Enbridge Gas websites (https://portal-plumprod.cgc.enbridge.com/portal/server.pt?open=512&objID=248&PageID=0&cached=true&mode=2&userID=2).

Payback Period = Incremental cost / (natural gas savings x natural gas cost)
= $600/ (117 m^3/year * $0.50 / m^3)
= 10 years

Market Share[17]	Medium/Low
Based on the observation of high market penetration of Energy Star qualified washers in two other jurisdictions (Washington State[18] – 48%, Iowa[19] – 72%) but the paucity of washers available from online retailers with specifications sufficient to qualify for CEE Tier 2 Navigant Consulting estimates the penetration in Ontario to be medium to low.	

Measure Assumptions Used by Other Jurisdictions

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
Puget Sound Energy, 2007[20]	70	14	600	48%
Comments No explicit assumptions made about base and efficient equipment for commercial clothes washers. For residential clothes washers, assumptions: base equipment, MEF = 1.0, efficient equipment, Energy Star Clothes Washer, MEF = 1.8. Measure saves 13% of 539 m^3 required for water heating.				
Source	**Annual Natural Gas Savings (m3)**	**Effective Useful Life (Years)**	**Incremental Cost ($)**	**Penetration/Market Share**
Efficiency Vermont, 2005[21]	20	14	$750	N/A
Comments Cost is reported as the full cost of the energy efficient equipment rather than the incremental cost. Savings calculated are per customer basis rather than a per machine basis. No indication given of percentage savings or base natural gas consumption for water heating.				

[17] Navigant Consulting is defining “Low” as below 5%, “Medium” as between 5-50%, and “High” as above 50%,
[18] Quantec *Comprehensive Assessment of Demand-Side Resource Potentials (2008-2027)* Prepared for Puget Sound Energy
[19] Iowa Utilities Board. Docket No. EEP-08-02 MidAmerican Energy Company. Volume IV, Appendix D, Part 1 of 2
[20] Quantec *Comprehensive Assessment of Demand-Side Resource Potentials (2008-2027)* Prepared for Puget Sound Energy
[21] Efficiency Vermont, Technical Reference User Manual (TRM) No. 2005 - 37

1.0 GAL/MIN FAUCET AERATOR (BATHROOM)

Commercial Building Retrofit (Installed) - Multi-Residential

Efficient Technology & Equipment Description
1.0 GPM Faucet Aerator
Base Technology & Equipment Description
Average existing stock / 2.2 GPM Faucet Aerator

Resource Savings Assumptions

Natural Gas (Updated)	**7 m^3**
As per EB 2008-0346 Decision, 1.5GPM aerator adjusted for a 1.0 GPM unit.	
Electricity	**n/a kWh**
Water (Updated)	**2,371 L**
As per EB 2008-0346 Decision, 1.5GPM aerator adjusted for a 1.0 GPM unit.	

Other Input Assumptions

Equipment Life	**10 years**
As recommended by Navigant.	
Incremental Cost (Contractor Install)	**$1.50**
As per utility program costs.	
Free Ridership (Updated)	**10 %**
Free ridership – EB 2008-0384 & 0385	

Faucet Aerator (Multi-Family Bathroom)

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description

Faucet Aerator (Bathroom) (1.5 GPM)

Base Equipment and Technologies Description

Average existing stock (2.2 GPM)[1]

Decision Type	Target Market(s)	End Use
Retrofit	Multi-Family (existing)	Water heating

Codes, Standards, and Regulations

Ontario Building Code (2006)[2] requires bathroom and kitchen faucets to have a maximum flow of 2.2 GPM (8.35 L/min).

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	4	0	1,382	2	0
2	4	0	1,382	0	0
3	4	0	1,382	0	0
4	4	0	1,382	0	0
5	4	0	1,382	0	0
6	4	0	1,382	0	0
7	4	0	1,382	0	0
8	4	0	1,382	0	0
9	4	0	1,382	0	0
10	4	0	1,382	0	0
TOTALS	**40**	**0**	**13,820**	**2**	**0**

[1] From on-site audit data. Resource Management Strategies, Inc. *Regional Municipality of York Water Efficiency Master Plan Update,* 2007. Cited in: Summit Blue, *Resource Savings Values in Selected Residential DSM Prescriptive Programs*, June 2008.
[2] Ontario Regulations 350/06, 2006 Building Code

Resource Savings Assumptions

Annual Natural Gas Savings	**4 m^3**

Assumptions and inputs:

- Average faucet water temperature: 30 ^oC (86 ^oF)[3]
- Average water inlet temperature: 9.33^oC (48.8 ^oF)[4]
- Average water heater energy factor: 0.76[5]

Annual gas savings calculated as follows:

$$Savings = W * 8.33 * (T_{out} - T_{in}) * \frac{1}{EF} * 10^{-6} * 27.8$$

Where:

W = Water savings (gallons)
8.33 = Energy content of water (Btu/gallon/^oF)
T_{out} = Faucet water temperature (^oF)
T_{in} = Water inlet temperature (^oF)
EF = Water heater recovery efficiency
10^{-6} = Factor to convert Btu to MMBtu
27.8 = Factor to convert MMBtu to m^3

Gas savings were determined to be 22% over base case:

$$Percent\ Savings = \frac{(G_{base} - G_{new})}{G_{base}}$$

Where:

G_{eff} = Annual natural gas use with efficient equipment, 18 m^3
G_{base} = Annual natural gas use with base equipment, 14 m^3

Annual Electricity Savings	**0 kWh**

N/A

Annual Water Savings	**1,382 L**

Assumptions and inputs:

- Average household size: 2.14 persons[6]
- Baseline faucet use (all faucets) per capita per day: 53 litres (14 gallons)[7]

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[3] Average of findings in two studies, adjusted for Toronto water inlet temperature. Mayer, P. W. et al, *Residential Indoor Water Conservation Study: Evaluation of High Efficiency Indoor Plumbing Fixture Retrofits in Single-Family Homes in East Bay Municipal Utility District Service Area,* 2003 and Skeel, T. and Hill, S. *Evaluation of Savings from Seattle's "Home Water Saver" Apartment/Condominium Program*, 1994. Both cited in: Summit Blue (2008).

[4] Cited in the following as personal communication with City of Toronto Works Dept. VEIC, *Comments on Navigant's Draft Gas Measure Characterizations*, March 2009

[5] Assumption used by Energy Center of Wisconsin, citing GAMA, www.doa.state.wi.us/docs_view2.asp?docid=2249

[6] Summit Blue (2008) and Census 2006. To maintain consistency with Summit Blue number but to reflect the fact that apartments are generally occupied by fewer people than houses, the Summit Blue number was degraded by the ratio of the average number of inhabitants per apartment in an Ontario building over five stories (2) to the average number of inhabitants of a fully detached house in Ontario (2.9).

[7] Ibid.

- Bathroom faucet use as a percentage of total faucet use: 15%[8]
- Point estimate of quantity of water that goes straight down the drain: 70%[9]

Annual water savings calculated as follows:

$$Savings = Fu * Ppl * 365 * Ba * \left(\frac{Fl_{base} - Fl_{eff}}{Fl_{base}} \right) * Dr$$

Where:

Fu = Faucet use per capita (gallons)
Ppl = Number of people per household
365 = Days per year
Dr = Percentage of water that goes straight down the drain
Ba = Individual bathroom faucet use as a percentage of total faucet use
Fl_{base} = Flow rate of base equipment (GPM)
Fl_{eff} = Flow rate of efficient equipment (GPM)

Water savings was determined to be 22% over base case:

$$PercentSavings = \frac{(W_{base} - W_{eff})}{W_{base}}$$

Where:

W_{eff} = Annual water use with efficient equipment: 4,823 litres (1,274 gallons)
W_{base}= Annual water use with base equipment: 6,205 litres (1,639 gallons)

Other Input Assumptions

Effective Useful Life (EUL)	10 Years
The U.S. DOE assumes a 10 year life for faucet aerators[10].	
Base & Incremental Conservation Measure Equipment and O&M Costs	**2 $**
Average equipment cost based on communication with local hardware stores. This does not include installation costs.	
Customer Payback Period (Natural Gas Only)[11]	**1 Year**
Using a 5-year average commodity cost (avoided cost)[12] of \$0.38 / m^3 and an average residential distribution cost[13] of \$0.14 / m^3, the payback period for natural gas savings is determined to be 1 year,	

[8] DeOreo, W. and P. Mayer, *The End Uses of Hot Water in Snigle Family Homes from Flow Trace Analysis*, 1999 cited in Summit Blue (2008).
[9] Summit Blue (2008).
[10] U.S. Department of Energy, Federal Energy Management Program, *FEMP Designated Product: Lavatory Faucets* http://www1.eere.energy.gov/femp/procurement/eep_faucets.html
[11] Customer payback period has been calculated using natural gas savings only. Where applicable, payback period is expected to decrease when electricity and/or water savings are included.

based on the following:

Payback Period = Incremental cost / (natural gas savings x natural gas cost)
$= \$2/ (4\ m^3/year * \$0.52 / m^3)$
= 1 year

Market Penetration	90%
Based on previous research conducted for the OPA, Navigant Consulting estimates penetration of faucet aerators (bathroom and kitchen) across all sectors to be 90%[14].	

Measure Assumptions Used by Other Jurisdictions

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/ Market Share
Puget Sound Energy[15]	5	5	N/A	50%
Comments For a switch from a 2.5 GPM to a 1.8 GPM aerator. Measure saves 1% of 539 m^3 required for water heating.Note that no distinction is made, in this study, between kitchen and bathroom faucet use.				
Source	**Annual Natural Gas Savings (m3)**	**Effective Useful Life (Years)**	**Incremental Cost ($)**	**Penetration/ Market Share**
State of Iowa Utilities Board[16]	27	9	14 US$	90%
Comments For a switch from a 3.0 GPM to a 1.5 GPM aerator. Measure saves 8.5% of 320 m^3 required for water heating. Note that no distinction is made, in this study, between kitchen and bathroom faucet use. Note also that the flow rate reduction in this jurisdiction is more than twice that of the measure addressed by this substantiation sheet.				

[12] 2009 Avoided gas cost provided by Union Gas. 5 year average avoided gas cost determined by taking average for baseload and weather sensitive avoided gas cost.
[13] Average distribution cost taken calculated from both Union Gas website (http://www.uniongas.com/residential/rates/) and Enbridge Gas websites (https://portal-plumprod.cgc.enbridge.com/portal/server.pt?open=512&objID=248&PageID=0&cached=true&mode=2&userID=2).
[14] Navigant Consulting, Inc. for the Ontario Power Authority, *Residential Rebate Program: Participation Forecast and Incentive Bundling Strategy – Key Findings Summary*, December 2008
[15] Quantec *Comprehensive Assessment of Demand-Side Resource Potentials (2008-2027)* Prepared for Puget Sound Energy
[16] Iowa Utilities Board. Docket No. EEP-08-02 MidAmerican Energy Company. Volume IV, Appendix D, Part 1 of 2

1.0 GAL/MIN FAUCET AERATOR (KITCHEN)

Commercial Building Retrofit (Installed) – Multi-Residential

Efficient Technology & Equipment Description
1.0 GPM Faucet Aerator
Base Technology & Equipment Description
Average existing stock / 2.5 GPM Faucet Aerator

Resource Savings Assumptions

Natural Gas (Updated)	**24 m^3**
As per EB 2008-0346 Decision, 1.5GPM aerator adjusted for a 1.0 GPM unit.	
Electricity	**n/a kWh**
Water (Updated)	**8,072 L**
As per EB 2008-0346 Decision, 1.5GPM aerator adjusted for a 1.0 GPM unit.	

Other Input Assumptions

Equipment Life	**10 years**
As approved in EB 2008-0346.	
Incremental Cost (Contractor Install)	**$2**
As per utility program costs.	
Free Ridership	**10 %**
Free ridership – EB 2008-0384 & 0385	

Faucet Aerator (Multi-Family Kitchen)

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description
Faucet Aerator (kitchen) (1.5 GPM)
Base Equipment and Technologies Description
Average existing stock (2.5 GPM)[1]

Decision Type	Target Market(s)	End Use
Retrofit	Multi-Family (existing)	Water heating

Codes, Standards, and Regulations

Ontario Building Code (2006)[2] requires bathroom and kitchen faucets to have a maximum flow of 2.2 GPM (8.35 L/min).

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	16	0	5,377	2	0
2	16	0	5,377	0	0
3	16	0	5,377	0	0
4	16	0	5,377	0	0
5	16	0	5,377	0	0
6	16	0	5,377	0	0
7	16	0	5,377	0	0
8	16	0	5,377	0	0
9	16	0	5,377	0	0
10	16	0	5,377	0	0
TOTALS	**160**	**0**	**53,770**	**2**	**0**

[1] From on-site audit data. Resource Management Strategies, Inc. *Regional Municipality of York Water Efficiency Master Plan Update,* 2007. Cited in: Summit Blue, *Resource Savings Values in Selected Residential DSM Prescriptive Programs*, June 2008.
[2] Ontario Regulations 350/06, 2006 Building Code

Resource Savings Assumptions

Annual Natural Gas Savings	16 m^3

Assumptions and inputs:

- Average faucet water temperature: 30 ^oC (86 F)[3]
- Average water inlet temperature: 9.33 ^oC (48.8 F)[4]
- Average water heater energy factor: 0.76[5]

Annual gas savings calculated as follows:

$$Savings = W * 8.33 * (T_{out} - T_{in}) * \frac{1}{EF} * 10^{-6} * 27.8$$

Where:

W = Water savings (gallons)
8.33 = Energy content of water (Btu/gallon/^oF)
T_{out} = Faucet water temperature (^oF)
T_{in} = Water inlet temperature (^oF)
EF = Water heater recovery efficiency
10^{-6} = Factor to convert Btu to MMBtu
27.8 = Factor to convert MMBtu to m^3

Gas savings were determined to be 20% over base case:

$$Percent\ Savings = \frac{(G_{base} - G_{new})}{G_{base}}$$

Where:

G_{eff} = Annual natural gas use with efficient equipment, 64 m^3
G_{base} = Annual natural gas use with base equipment, 80 m^3

Annual Electricity Savings	0 kWh

N/A

Annual Water Savings	5,377 L

Assumptions and inputs:

- Average household size: 2.14 persons[6]

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[3] Average of findings in two studies, adjusted for Toronto water inlet temperature. Mayer, P. W. et al, *Residential Indoor Water Conservation Study: Evaluation of High Efficiency Indoor Plumbing Fixture Retrofits in Single-Family Homes in East Bay Municipal Utility District Service Area,* 2003 and Skeel, T. and Hill, S. *Evaluation of Savings from Seattle's "Home Water Saver" Apartment/Condominium Program*, 1994. Both cited in: Summit Blue (2008).

[4] Cited in the following as personal communication with City of Toronto Works Dept. VEIC, *Comments on Navigant's Draft Gas Measure Characterizations,* March 2009

[5] Assumption used by Energy Center of Wisconsin, citing GAMA, www.doa.state.wi.us/docs_view2.asp?docid=2249

[6] Summit Blue (2008) and Census 2006. To maintain consistency with Summit Blue number but to reflect the fact that apartments are generally occupied by fewer people than houses, the Summit Blue number was degraded by the ratio of the average number of inhabitants per apartment in an Ontario building over five stories (2) to the average number of inhabitants of a fully detached house in Ontario (2.9). Statistics Canada. No date. *Structural Type of Dwelling (10) and Household Size (9) for Occupied Private Dwellings of Canada, Provinces, Territories, Census Metropolitan Areas and Census Agglomerations, 2006 Census - 100% Data* (Table) *Census 2006.* Last updated Dec 6, 2008. http://www12.statcan.ca/english/census06/data/topics/RetrieveProductTable.cfm?ALEVEL=3&APATH=3&CATNO=&DETAIL=0&

- Baseline faucet use (all faucets) per capita per day: 53 litres (14 gallons)[7]
- Kitchen faucet use as a percentage of total faucet use: 65%[8]
- Point estimate of quantity of water that goes straight down the drain: 50%[9]

Annual water savings calculated as follows:

$$Savings = Fu * Ppl * 365 * Ba * \left(\frac{Fl_{base} - Fl_{eff}}{Fl_{base}} \right) * Dr$$

Where:

Fu = Faucet use per capita (gallons)
Ppl = Number of people per household
365 = Days per year
Dr = Percentage of water that goes straight down the drain
Ki = Kitchen faucet use as a percentage of total faucet use
Fl_{base} = Flow rate of base equipment (GPM)
Fl_{eff} = Flow rate of efficient equipment (GPM)

Water savings was determined to be 20% over base case:

$$PercentSavings = \frac{(W_{base} - W_{eff})}{W_{base}}$$

Where:

W_{eff} = Annual water use with efficient equipment: 21,509 litres (5,681gallons)
W_{base}= Annual water use with base equipment: 26,887litres (7,101 gallons)

Other Input Assumptions

Effective Useful Life (EUL)	**10 Years**
The U.S. DOE assumes a 10 year life for faucet aerators[10].	
Base & Incremental Conservation Measure Equipment and O&M Costs	**2 $**
Average equipment cost based on communication with local hardware stores. This does not include installation costs.	
Customer Payback Period (Natural Gas Only)[11]	**0.2 Years**

DIM=&DS=99&FL=0&FREE=0&GAL=0&GC=99&GID=837983&GK=NA&GRP=1&IPS=&METH=0&ORDER=1&PID=89071&PTYPE=88971&RL=0&S=1&SUB=0&ShowAll=No&StartRow=1&Temporal=2006&Theme=69&VID=0&VNAMEE=&VNAMEF=

[7] Ibid.

[8] DeOreo, W. and P. Mayer, *The End Uses of Hot Water in Snigle Family Homes from Flow Trace Analysis*, 1999 cited in Summit Blue (2008).

[9] Summit Blue (2008).

[10] U.S. Department of Energy, Federal Energy Management Program, *FEMP Designated Product: Lavatory Faucets* http://www1.eere.energy.gov/femp/procurement/eep_faucets.html

Using a 5-year average commodity cost (avoided cost)[12] of $0.38 / m^3 and an average residential distribution cost[13] of $0.14 / m^3, the payback period for natural gas savings is determined to be 0.2 years, based on the following: Payback Period = Incremental cost / (natural gas savings x natural gas cost) = $2/ (16 m^3/year * $0.52 / m^3) = 0.2 years	
Market Penetration	**90%**
Based on previous research conducted for the OPA, Navigant Consulting estimates penetration of faucet aerators (bathroom and kitchen) across all sectors to be 90%[14].	

Measure Assumptions Used by Other Jurisdictions

Source	Annual Natural Gas Savings (m3)	Effective Useful Life (Years)	Incremental Cost ($)	Penetration/Market Share
Puget Sound Energy[15]	5	5	N/A	50%
Comments For a switch from a 2.5 GPM to a 1.8 GPM aerator. Measure saves 1% of 539 m^3 required for water heating. Note that no distinction is made, in this study, between kitchen and bathroom faucet use.				
Source	**Annual Natural Gas Savings (m3)**	**Effective Useful Life (Years)**	**Incremental Cost ($)**	**Penetration/Market Share**
State of Iowa Utilities Board[16]	27	9	14 US$	90%
Comments For a switch from a 3.0 GPM to a 1.5 GPM aerator. Measure saves 8.5% of 320 m^3 required for water heating. Note that no distinction is made, in this study, between kitchen and bathroom faucet use. Note also that the flow rate reduction in this jurisdiction is more than twice that of the measure addressed by this substantiation sheet.				

[11] Customer payback period has been calculated using natural gas savings only. Where applicable, payback period is expected to decrease when electricity and/or water savings are included.
[12] 2009 Avoided gas cost provided by Union Gas. 5 year average avoided gas cost determined by taking average for baseload and weather sensitive avoided gas cost.
[13] Average distribution cost taken calculated from both Union Gas website (http://www.uniongas.com/residential/rates/) and Enbridge Gas websites (https://portal-plumprod.cgc.enbridge.com/portal/server.pt?open=512&objID=248&PageID=0&cached=true&mode=2&userID=2).
[14] Navigant Consulting, Inc. for the Ontario Power Authority, *Residential Rebate Program: Participation Forecast and Incentive Bundling Strategy – Key Findings Summary*, December 2008
[15] Quantec *Comprehensive Assessment of Demand-Side Resource Potentials (2008-2027)* Prepared for Puget Sound Energy
[16] Iowa Utilities Board. Docket No. EEP-08-02 MidAmerican Energy Company. Volume IV, Appendix D, Part 1 of 2

Low-Flow Showerhead (Various GPM, Enbridge TAPS, ESK and Multi-Family)

Revision #	Description/Comment	Date Revised
		September 20, 2010

Efficient Equipment and Technologies Description	
Low-flow Showerhead (1.25 or 1.5 GPM) – distributed to participants under Enbridge's TAPS program, Enbridge's ESK program, Enbridge's Multi-Family program and Enbridge's Low-Income program.	
Base Equipment and Technologies Description	
Enbridge TAPS (existing only)	– 2.45 GPM or – 3.07 GPM[1]
Enbridge ESK (new only)	– Maximum allowable by OBC (2.5 GPM)
Enbridge Multi-Family (MF) (existing only)	– 2.25 GPM – 2.8 GPM – 3.3 GPM – 3.6 GPM[2]
Enbridge Multi-Family (MF) (new only)	– Maximum allowable by OBC (2.5 GPM)
Enbridge Low-Income	– 2.45 GPM or – 3.07[3]

Decision Type	Target Market(s)	End Use
Enbridge TAPS - Existing, Enbridge ESK – New Only, Enbridge MF – New and Existing	Residential, Low-Income, Multi-family	Water heating

[1] Enbridge load research indicates that that the average bag-tested flow rate for showerheads that fall within the 2.0 – 2.5 GPM bucket is 2.45 GPM and that the average bag-tested flow rate for showerheads that fall within the >2.5 GPM bucket is 3.07.

[2] Enbridge contractors install the showerheads as part of the Enbridge Multi-Family program. The base measure is reported as falling in one of four buckets, 2.0 – 2.5 GPM, 2.6 – 3.0 GPM, 3.1 – 3.5 GPM and greater than 3.6 GPM. Navigant has assumed that in each case the average base technology GPM for each of the first three buckets is the mid-point and that the average GPM for the fourth bucket is the lowest possible value; 3.6 GPM

[3] The average GPM of low-income households' showerheads is assumed by Navigant to be no different than that of standard single family households'.

Codes, Standards, and Regulations

Ontario Building Code (2006)[4] requires shower heads to have a maximum flow of 2.5 GPM (9.5 L/min).

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	21 – 82	0	5,931 – 23,374	6	0
2	21 – 82	0	5,931 – 23,374	0	0
3	21 – 82	0	5,931 – 23,374	0	0
4	21 – 82	0	5,931 – 23,374	0	0
5	21 – 82	0	5,931 – 23,374	0	0
6	21 – 82	0	5,931 – 23,374	0	0
7	21 – 82	0	5,931 – 23,374	0	0
8	21 – 82	0	5,931 – 23,374	0	0
9	21 – 82	0	5,931 – 23,374	0	0
10	21 – 82	0	5,931 – 23,374	0	0
TOTALS	**215 - 815**	**0**	**59,307 – 233,744**	**EG TAPS 1.25 GPM = $19.00** **EG LI 1.25 GPM = $18.71** **EG ESK 1.25 GPM = $4.26** **EG ESK 1.5 GPM = $12.50** **EG ESK 1.5 & 1.25 GPM = $16.76** **EG Multi-Fam 1.5 GPM = $12.50** **EG Multi-Fam 1.25 GPM = $12.50**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	21 – 82 m^3

Enbridge Gas commissioned a study by the SAS Institute (Canada)[5] to estimate natural gas savings for low-flow showerheads in Enbridge territory. Data was collected August 31, 2007 until August 31, 2009 for both treatment and control groups. Low flow showerheads were installed in treatment households between August 13, 2008 and October 30, 2008. There were 54 households with low-flow showerheads and 124 households without low-flow showerheads.

To calculate the gas savings, three different models were used to analyze the gas consumption data
1) a comparison made during the same time frame (post-installation) between a control set of households[6] and households that had them installed
2) a Pre & Post installation analysis on the same households, and
3) a complex time trend model analysis that factored in many household characteristics over the whole Pre & Post time period.

All three analyses agreed well with each other.[7]

Three buckets for pre-existing showerheads were originally proposed. However, the lowest flow bucket (2.0 GPM or less) had too few observations and are rare in the population of households. The natural gas savings for the other two buckets are estimated to be as follows:

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[4] Ontario Regulations 350/06, 2006 Building Code
[5] Rothman, Lorne, SAS® PHASE II Analysis for Enbridge Gas Distribution Inc.: Estimating the Impact of Low-Flow Showerhead Installation; April 5, 2010
[6] Where no low-flow showerheads were ever installed
[7] Model 1 – a blended rate of 71.3 m3/yr (only models II and II provided bucketed savings estimates)
Model 2 – a blended rate of 67.4 m3/yr (45.4 m3/yr for 2 to 2.5 GPM bucket and 87.8 m3/yr for over 2.5 GPM), and
Model 3 – a blended rate of 77.2 m3/yr (46.4 m3/yr for 2 to 2.5 GPM bucket and 87.9 m3/yr for over 2.5 GPM).

Table 1 - SAS Study Results

Bucket for Base Showerhead	Average Flow Rate of SAS Sample (GPM)	Annual Natural Gas Savings (m3)
2.0 to 2.5 GPM	2.36	46
> 2.5 GPM	3.19	88

To extrapolate the savings estimates reported in the SAS study to the base technologies under consideration several steps are required.

1. Estimate the "as-used" flow of the base and efficient technologies.

In its report on showerhead savings, Summit Blue[8], notes that the actual flow-rate as used in showers has been found to differ somewhat from the nominal flow-rate. Citing a 1994 California study, they provide an equation for calculating the "as-used" flow:

As-used flow rate (GPM) = 0.691 + 0.542*Nominal flow rate (GPM)

Navigant notes that applying this equation to a showerhead with a 1.25 GPM flow rate would result in an as-used flow rate that is greater than the nominal flow rate. Navigant has therefore applied a somewhat modified version of the equation above to determine the as-used flow rate. The as-used flow rate is estimated to be the minimum of either the result of the equation above or the nominal flow rate.

Applying the modified equation to Table 1, above, we obtain the following:

Table 2 - As-Used Flow

Nominal Flow (GPM)		As-Used Flow (GPM)		Delta As-Used Flow (GPM)	Observed Savings (m^3)
Base Technology	Efficient Measure	Base Technology	Efficient Measure		
2.36	1.25	1.97	1.25	0.72	46
3.19	1.25	2.42	1.25	1.17	88

2. Estimate the average annual natural gas consumption of a 1.25 GPM showerhead.

Based on the values above, Navigant has estimated that the annual natural gas consumption of the 1.25 GPM showerhead is 87 m^3 per year.

Table 3 - Annual Natural Gas Consumption of a 1.25 GPM Showerhead

Delta As-Used Flow (GPM)	Observed Savings (m^3)	Efficient Technology As-Used Flow (GPM)	Implied Annual Gas Consumption of Efficient Technology (m^3)	Average (m^3)
A	B	C	D = (C/A)*B	E = Average(D)
0.72	46	1.25	80	87
1.17	88	1.25	94	

[8] Summit Blue, *Resource Savings Values in Selected Residential DSM Prescriptive Programs*, prepared for Union Gas and Enbridge Gas Distribution, June 2008

3. Extrapolate the implied annual natural gas consumption of showerheads in both buckets identified by the SAS Institute.

Extrapolating these values is simply a matter of adding the estimated savings by bucket to the estimated annual consumption of the 1.25 GPM showerhead.

Table 4 - Implied Annual Natural Gas Consumption by Showerhead Flow Rate

Nominal Flow Rate (GPM)	Implied Annual Natural Gas Consumption (m3)
1.25	87
2.36	133
3.19	175

4. Estimate an equation from which the annual natural gas consumption of showerheads with flow rates different to those above may be extrapolated.

Fitting a polynomial equation to the three data-points in Table 4 above delivers the following equation which may be used to extrapolate the annual natural gas consumption of a given showerhead:

$$y = 49.06 + 24.39x + 4.72x^2$$

Where:

y = Annual natural gas consumption (m^3)
x = Nominal GPM of showerhead

Navigant notes that given the manner in which this equation was derived, and the values of the parameters, it may be inappropriate to use this equation to extrapolate the annual natural gas consumption of showerheads with a nominal flow rate that is less than 1.25 GPM.

In multi-family homes, Navigant has adjusted savings based on number of occupants per household to reflect differences in patterns of use. The adjustment factor is the fraction of average number of occupants per household in an apartment building over the average number of occupants per household in a single-detached house[9]. This factor is (2/2.9) = 69% for buildings over 5 stories and (1.9/2.9) = 66% for buildings of five stories or less. The average of these two factors, weighted by the number of each type of household is 68%.

It should be noted that the savings below are per household and predicated on the assumption that all showers taken in that household are taken using a shower with the low-flow showerhead. In the program measurement and verification stage, Enbridge will undertake to determine what proportion of showers per household were taken with the efficient measure and apply this factor to previously calculated savings.

[9] Statistics Canada. *Structural Type of Dwelling (10) and Household Size (9) for Occupied Private Dwellings of Canada, Provinces, Territories, Census Metropolitan Areas and Census Agglomerations, 2006 Census - 100% Data* (Table) *Census 2006.* Last updated Dec 6, 2008.
http://www12.statcan.ca/english/census06/data/topics/RetrieveProductTable.cfm?ALEVEL=3&APATH=3&CATNO=&DETAIL=0&DIM=&DS=99&FL=0&FREE=0&GAL=0&GC=99&GID=837983&GK=NA&GRP=1&IPS=&METH=0&ORDER=1&PID=89071&PTYPE=88971&RL=0&S=1&SUB=0&ShowAll=No&StartRow=1&Temporal=2006&Theme=69&VID=0&VNAMEE=&VNAMEF=

Table 5 - Natural Gas Savings

Program	Applicable Customer Group	Base Flow Rate	Efficient Measure Flow Rate	Annual Gas Savings (m^3)	Lifetime Gas Savings (m^3)
EG TAPS	Standard Res	2.45	1.25	50	502
EG TAPS	Standard Res	3.07	1.25	82	815
EG Low-Income	LIA	2.45	1.25	50	502
EG Low-Income	LIA	3.07	1.25	82	815
EG ESK (New Only)	Standard Res	2.50	1.25	53	526
EG ESK (New Only)	Standard Res	2.50	1.50	43	433
EG ESK (New Only)	Standard Res	2.50	1.25 & 1.5*	48	480
EG MF (New Only)	Multi-Family	2.50	1.25	36	358
EG MF (New Only)	Multi-Family	2.50	1.50	29	294
EG MF	Multi-Family	2.25	1.50	21	215
EG MF	Multi-Family	2.80	1.50	40	395
EG MF	Multi-Family	3.30	1.50	58	576
EG MF	Multi-Family	3.60	1.50	69	692

** Participants in Enbridge's ESK program receive both a 1.25 and 1.5 GPM showerhead. Navigant has assumed that both are used equally and that resultant household savings are equivalent to the average savings of a household that receives only 1.5 GPM showerheads and a household that receives only 1.25 GPM showerheads. Enbridge has indicated that in the future new households may receive either only 1.5 or 1.25 GPM showerheads. These households would attain the corresponding savings shown above.*

Annual Electricity Savings — 0 kWh

N/A

Annual Water Savings — 5,931 – 23,374 L

Since the SAS report did not look at water savings, Navigant Consulting proposes the following method for calculating resulting water savings:

Assumptions and inputs:

- As-used flow rate with base and efficient equipment:

Base Technology Nominal GPM	Base Technology As-Used GPM
2.45	2.02
3.07	2.35
2.5	2.05
2.25	1.91
2.8	2.21
3.3	2.48
3.6	2.64

Efficient Technology Nominal GPM	Efficient Technology As-Used GPM
1.25	1.25
1.5	1.50

- Average household size: 3.1 persons (Standard Res and LIA)[10], 2.09 persons (Multi-family)[11]

[10] Summit Blue (2008).
[11] To maintain consistency with Summit Blue number but to reflect the fact that apartments are generally occupied by fewer people than houses, the Summit Blue number was degraded by the ratio of the average number of inhabitants per apartment (1.96) to the average number of inhabitants of a fully detached house in Ontario (2.9). Statistics Canada. No date. *Structural Type of Dwelling (10) and Household Size (9) for Occupied Private Dwellings of Canada, Provinces, Territories, Census Metropolitan Areas and*

- Showers per capita per day: 0.75[12]
- Average showering time per capita per day with base and efficient equipment[13]:

Base Technology	
As-Used GPM	Showering Time
2.02	7.28
2.35	7.13
2.05	7.27
1.91	7.33
2.21	7.20
2.48	7.08
2.64	7.01

Efficient Technology	
As-Used GPM	Showering Time
1.25	7.62
1.5	7.51

Annual water savings calculated as follows:

$$Savings = Ppl * Sh * 365 * \left(T_{base} * Fl_{base} - T_{eff} * Fl_{eff}\right)$$

Where:

Ppl = Number of people per household
Sh = Showers per capita per day
365 = Days per year
T_{base} = Showering time with base equipment (minutes)
T_{eff} = Showering time with efficient equipment (minutes)
Fl_{base} = As-used flow rate with base equipment (GPM)
Fl_{eff} = As-used flow rate with efficient equipment (GPM)

Census Agglomerations, 2006 Census - 100% Data (Table) *Census 2006.* Last updated Dec 6, 2008. http://www12.statcan.ca/english/census06/data/topics/RetrieveProductTable.cfm?ALEVEL=3&APATH=3&CATNO=&DETAIL=0&DIM=&DS=99&FL=0&FREE=0&GAL=0&GC=99&GID=837983&GK=NA&GRP=1&IPS=&METH=0&ORDER=1&PID=89071&PTYPE=88971&RL=0&S=1&SUB=0&ShowAll=No&StartRow=1&Temporal=2006&Theme=69&VID=0&VNAMEE=&VNAMEF=

[12] Summit Blue (2008), based on data from: Resource Management Strategies, Inc., Regional Municipality of York Water Efficiency Master Plan Update, April 2007

[13] Relationship modeled as: Average shower length = 8.17 – 0.448 * as-used GPM. From Energy Center of Wisconsin Analysis of data from Resource Management Strategies, Inc., *Regional Municipality of York Water Efficiency Master Plan Update,* April 2007. Cited in Summit Blue (2008)

Table 6 - Annual Water Savings

Program	Applicable Customer Group	Base Flow Rate	Efficient Measure Flow Rate	Base Flow Rate (as-used)	Efficient Measure Flow Rate (as-used)	Annual Water Savings (L)	Lifetime Water Savings (L)
EG TAPS	Standard Res	2.45	1.25	2.02	1.25	16,631	166,309
EG TAPS	Standard Res	3.07	1.25	2.35	1.25	23,374	233,744
EG Low-Income	LIA	2.45	1.25	2.02	1.25	16,631	166,309
EG Low-Income	LIA	3.07	1.25	2.35	1.25	23,374	233,744
EG ESK (New Only)	Standard Res	2.50	1.25	2.05	1.25	17,187	171,866
EG ESK (New Only)	Standard Res	2.50	1.50	2.05	1.50	11,596	115,958
EG ESK (New Only)	Standard Res	2.50	1.25 & 1.5*	2.05	1.38	14,391	143,912
EG MF (New Only)	Multi-Family	2.50	1.25	2.05	1.25	11,587	115,871
EG MF (New Only)	Multi-Family	2.50	1.50	2.05	1.50	7,818	78,178
EG MF	Multi-Family	2.25	1.50	1.91	1.50	5,931	59,307
EG MF	Multi-Family	2.80	1.50	2.21	1.50	10,036	100,362
EG MF	Multi-Family	3.30	1.50	2.48	1.50	13,621	136,214
EG MF	Multi-Family	3.60	1.50	2.64	1.50	15,705	157,054

** Participants in Enbridge's ESK program receive both a 1.25 and 1.5 GPM showerhead. Navigant has assumed that both are used equally and that resultant household savings are equivalent to the average savings of a household that receives only 1.5 GPM showerheads and a household that receives only 1.25 GPM showerheads. Enbridge has indicated that in the future new households may receive either only 1.5 or 1.25 GPM showerheads. These households would attain the corresponding savings shown above.*

Other Input Assumptions

Effective Useful Life (EUL)	10 Years
Summit Blue (2008) suggests an EUL of 10 years based on a survey of five studies of showerheads in other jurisdictions (California – two studies, New England, Vermont, Arkansas).	
Incremental Costs	**EG TAPS 1.25 GPM = $19.00** **EG LI 1.25 GPM = $18.71** **EG ESK 1.25 GPM = $4.26** **EG ESK 1.5 GPM = $12.50** **EG ESK 1.5 & 1.25 GPM = $16.76** **EG Multi-Fam 1.5 GPM = $12.50** **EG Multi-Fam 1.25 GPM = $12.50**
Incremental cost for EG TAPS, ESK, LI and Multi-Family based on utility bulk purchase costs.	

TABLE OF MEASURE LIVES

1. The following table presents measure life assumptions for technologies commonly used in Custom Resource Acquisition projects.

2. With one exception, all the assumptions have been approved by the Ontario Energy Board (the "Board") in previous Enbridge Gas Distribution Inc. (the "Company" or "Enbridge") Demand Side Management ("DSM") proceedings.

3. With this Multi-year plan application; Enbridge is submitting a revised measure life for steam traps for Board approval. The previous measure life assumption was for six years. Based on a research study which Enbridge commissioned and the recommendation of the DSM auditor in the Company's 2010 DSM results, Enbridge proposes to change the steam trap measure life from six years to five years.

Witnesses: P. Goldman
A. Mandyam
J. Ramsay
S. Surdu

Custom Resource Acquisition Technologies

Table 1 - Measure Life Assumptions

	Commercial	Industrial	Multi-residential
Boiler Related			
Boilers – DHW	25[1]	n/a	25[1]
Boilers - Industrial Process	n/a	20	n/a
Boilers – Space Heating	25[1]	25[1]	25[1]
Combustion Tune-up	5	5	n/a
Controls	15	15	15
Steam pipe/tank insulation	n/a	15	n/a
Steam trap	5[4]	5[4]	n/a
Building Related			
Building envelope	25	25	25
Windows	25	25	25
Greenhouse curtains	n/a	10	n/a
Double Poly greenhouse	n/a	5	n/a
HVAC Related			
Dessicant cooling	15	n/a	n/a
Heat Recovery	15	15	n/a
Infra-red heaters	10	10	n/a
Make-up Air	15	15	15
Novitherm panels	15	n/a	15
Furnaces (gas-fired)	18[2]	n/a	18[2]
Re-Commissioning	5[3]	n/a	5[3]
Process Related			
Furnaces (gas-fired)	n/a	18[2]	n/a

[1]Source: ASHRAE.
[2]Source: ASHRAE updated in EB-2006-0021.
[3] Source: Measure Life For Retro-Commissioning And Continuous Commissioning Projects, Finn Projects.
[4] Source: Enbridge Gas Distribution Independent Audit of 2010 DSM Program Results, June 30, 2011, Pg. 54.

Natural Gas
Energy Efficiency Potential: Update 2008

Residential, Commercial and Industrial Sectors
Synthesis Report

Submitted to:

Enbridge Gas Distribution

Submitted by:

Marbek Resource Consultants Ltd.

September 2009

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Note: Report analysis substantially completed in December 2008.

List of Exhibits

1. INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

Enbridge Gas Distribution (Enbridge) is the largest natural gas utility in Canada with 1.9 million residential, commercial and industrial customers. Enbridge is a regulated utility with a Service Area in central and eastern Ontario that includes the cities of Toronto and Ottawa and the Niagara Region. Enbridge distributes approximately 13 billion m^3 of natural gas to its customers annually.

Since 1995, Enbridge has been delivering demand side management (DSM) programs to its customers following a decision of the provincial regulator, the Ontario Energy Board (OEB). Enbridge offers DSM programs to all customer rate classes and across all sectors.

Enbridge has been participating in a market of increasing DSM program maturity. This market is continually evolving in its engagement with energy efficiency through growing voluntary initiatives and more stringent codes and standards. In addition, changes in the economy have started to have negative impact on the commercial and industrial marketplace in Enbridge's Service Area.

In the DSM Generic Proceeding held in 2006, Enbridge committed to creating an updated Market Potential Study for input into the next DSM plan. When completed, the results of this Natural Gas Energy Efficiency Potential Study will provide a foundation that Enbridge can use to guide the development of its longer-term DSM strategy, including new programs. More specifically, this includes support for Enbridge's filing to the OEB regulatory application for the next multi-year DSM plan by:

- Estimating the achievable and economic potential for DSM measures across all applicable technologies, markets and sectors in Enbridge's Service Area
- Giving shape to, and refining ongoing energy-efficiency work by Enbridge in order to develop its next multi-year DSM plan, and
- Provide information that is actionable and can be easily converted to plan and program development.

1.2 STUDY SCOPE

This current study (Update 2008) is an update of the earlier Natural Gas Efficiency Potential Study that was completed for Enbridge in 2006. Consequently, to the extent possible, this study employs the same methodology, sector definitions, facility archetypes and geographical coverage as in the previous study. Additional details are provided below:

- **Sector Coverage:** The study addresses three sectors: Residential, Commercial[1] and Industrial.

[1] Throughout this report the term "Commercial" also includes institutional sectors, such as schools, hospitals, etc., unless otherwise noted.

- **Geographical Coverage**: The study results are presented for the total Enbridge Service Area and for two service regions: Central and Eastern. The study results are presented at the level of individual service region due to differences in building stock and weather conditions (heating degree days) that exist in the two regions.

  The Central service region is dominated by the Greater Toronto Area, but also includes customers in the Niagara region. Major municipalities in the Central service region include: Metropolitan Toronto (01), Mississauga (21), Richmond Hill (35), Whitby (45), and Niagara (76). The Eastern region is dominated by the City of Ottawa. Major municipalities in the Eastern service region include: Peterborough (47), Barrie (53), and Ottawa (65).

- **Study Period**: This study covers a 10-year period. The Base Year is the calendar year 2007, with milestone periods at five-year increments: 2012 and 2017. The Base Year of 2007 was selected, as this was the most recent calendar year for which complete customer data were available.

- **Technologies:** The study addresses the full range of natural gas energy efficiency measures together with selected renewable energy technologies that are currently commercially available, or are expected to be available within the first 5 years of this study period.

  The study also provides a high-level treatment of selected emerging technologies. Although it is not expected that these emerging technologies will significantly affect results in this study period, they provide insight into possible future directions that may influence the market for higher efficiency products.

1.2.1 Caveats

Readers are reminded of the following caveats when reviewing the results presented in this report:

- Energy Efficiency Potential studies, such as this one, provide a “big picture” assessment of the scope of energy efficiency opportunities within a specific service area. They are particularly valuable in identifying the level of aggregate savings, the key measures involved, their costs and the relative priority of individual sub markets and technologies. Because these studies must assess literally hundreds of combinations of technologies and sub markets, the assessment is necessarily high level. As such, these study results are intended to provide a foundation for detailed program design, but it must be emphasized that detailed program design requires substantial additional analysis.

- During the completion of this study, the world economy entered a period of unprecedented uncertainty that may have significant impact on the results of this study, particularly in the short term. For example, key factors underlying Enbridge’s load forecast and the study’s Reference Case such as gross domestic product (GDP), energy prices, new construction etc. may change. The net effect of these changes would be lower levels of future natural gas consumption. Similarly, the participation rates estimated during the Achievable Potential workshops do not explicitly take into account changes in consumer outlook as a result of the economic downturn. Although neither the extent nor the duration of the economic downturn is known at this time, the expected impact would be lower consumer spending and, hence, lower program participation rates than those presented in this report. The precise magnitude of the reduced program participation is unknown at this time.

- The analysis was conducted based on the current and expected future participation of other industry partners such as the federal government, led by Natural Resources Canada, the Ontario government, and the Ontario Power Authority (OPA). At the time of this writing, the future energy efficiency strategies and complementary programs to be pursued by these agencies is not certain. Over the duration of this forecast, impacts due to the changing roles of industry partners should be assessed from time to time and, in particular, should be included within Enbridge's following multi-year plan.

- The inclusion of natural conservation in the study's Reference Case does address some, but not necessarily all, free rider and spillover impacts. A more detailed assessment of free rider impacts is practical only as part of a detailed program design, which is beyond the scope of this study.

- As in any study of this type, the results presented in this report are based on a large number of important assumptions. Assumptions such as those related to the current and forecast costs of natural gas, the current penetration of energy efficient technologies, the rate of future economic growth and customer willingness to implement new energy efficiency measures are particularly influential. Wherever possible, the assumptions used in this study are consistent with those used by Enbridge and are based on best available information, which in many cases includes the professional judgement of the consultant team, client personnel and/or local experts. The reader should use the results presented in this report as best available estimates; major assumptions, information sources and caveats are noted throughout the report.

1.3 DEFINITIONS

This study employs numerous terms that are unique to analyses such as this one and consequently it is important to ensure that all readers have a clear understanding of what each term means when applied to this study. Below is a brief description of some of the most important terms.

Base Year Natural Gas Use
The Base Year is the starting point for the analysis. It provides a detailed description of "where" and "how" natural gas is currently used in each sector. The bottom up profile of energy use patterns and market shares of energy using technologies was calibrated to actual Enbridge customer sales data.

Reference Case Forecast
The Reference Case is a projection of natural gas consumption to 2017, in the absence of any new Enbridge DSM market interventions after 2008. It is the baseline against which the scenarios of energy savings are calculated. The Reference case forecast incorporates an estimation of "natural conservation", namely, changes in end use efficiency over the study period that are projected to occur in the absence of new market interventions by Enbridge.

Measure Total Resource Cost
The Measure TRC calculates the net benefits that result from an investment in an efficiency technology or measure. The measure TRC is equal to its full or incremental capital cost (depending on application) plus any change (positive or negative) in the combined annual energy, water and equipment O&M costs. This calculation includes, among others, the following inputs: the avoided natural gas, electricity and water supply costs, the life of the technology, and the selected discount rate, which in this analysis has been set at 9.14%.

The Measure Total Resource Cost (TRC) test is the primary determinant of whether a measure is included in the economic potential.

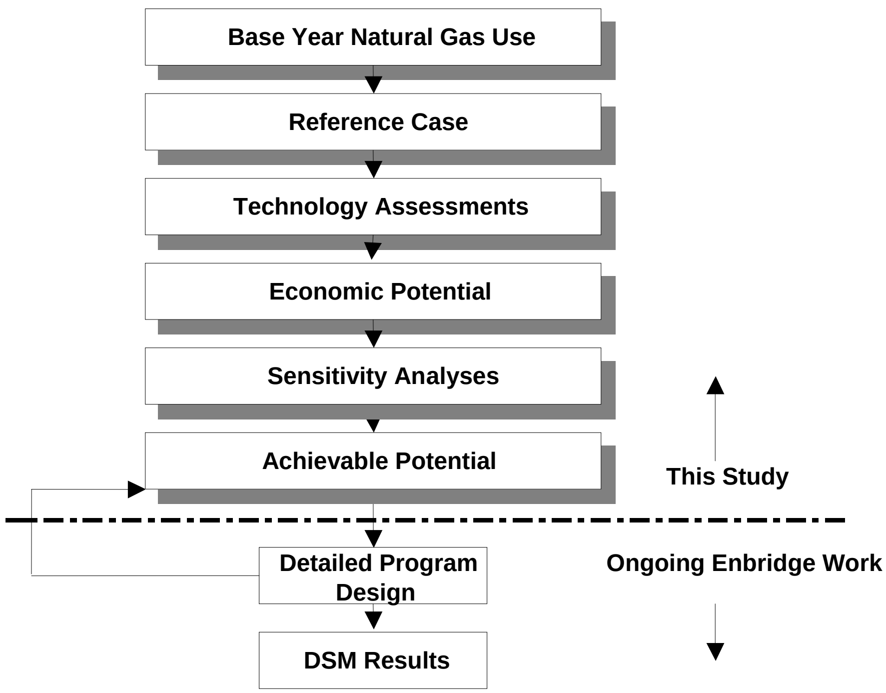
Economic Potential Forecast
The Economic Potential Forecast is the level of natural consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost-effective from Enbridge's perspective. All the energy efficiency technologies and measures that have a positive measure TRC are incorporated into the Economic Potential Forecast. These technologies and measures are applied at either natural stock turnover rates or at designated years for immediate application.

Achievable Potential The Achievable Potential is the proportion of the natural gas savings identified in the Economic Potential Forecast that could realistically be achieved within the study period. Achievable Potential recognizes that it is practically difficult to induce customers to purchase and install all the efficiency technologies that meet the criteria defined by the Economic Potential Forecast.

1.4 APPROACH

To meet the objectives outlined above, the study was conducted through an iterative process that involved a number of well-defined steps. At the completion of each step, the client reviewed the results and, as applicable, revisions were identified and incorporated into the interim results. The study then progressed to the next step. A summary of the steps is presented in Exhibit 1.1 and briefly discussed below.

Exhibit 1.1: Major Study Steps



Step 1: Develop Base Year Calibration Using Actual Enbridge Sales Data

The Base Year (2007) is the starting point for the analysis. It provides a detailed description of "where" and "how" natural gas is currently used, based on actual natural gas sales.

The consultants compiled the best available data and used sector-specific macro models to estimate natural gas use; they then compared the results to the Enbridge's actual billing data to verify their accuracy.

Step 2: Develop Reference Case

The Reference Case uses the same sector-specific macro models to estimate the expected level of natural gas consumption that would occur over the study period with no new (post-2007) Enbridge DSM initiatives. The Reference Case includes projected increases in natural gas consumption based on expected rates of population and economic growth, using the growth rates included in the Enbridge 2007 load forecast. The Reference Case also makes an estimate for some "natural" conservation, that is, conservation that occurs without Enbridge DSM programs. The Reference Case provides the point of comparison for the calculation of Technical, Economic and Achievable natural gas saving potentials.

Step 3: Assess DSM Technologies

The consultants researched a wide range of commercially available DSM technologies and measures that can enable the Enbridge customers to use natural gas more efficiently. For each DSM technology or measure, the consultants calculated a value for the net benefits per year per cubic meter (m^3) of saved natural gas, referred to as the measure Total Resource Cost (TRC).

This approach allowed the consultants to compare the measure TRC benefits with other natural gas efficiency technologies and measures, and to determine whether or not to include the DSM measure in the Economic Potential Forecast. Only technologies and measures with positive TRC benefits were included in the Economic Potential Forecast.

Step 4: Estimate Economic Natural Gas Savings Potential

The Economic Potential Forecast incorporates all "cost-effective" DSM measures reviewed in Step 3. To forecast the potential natural gas savings that are defined as economic, the consultants used the sector-specific macro models to calculate the level of natural gas consumption that would occur if Enbridge's customers installed all "cost-effective" technologies. "Cost effective" for the purposes of this study means that the measure has a positive measure TRC.

Step 5: Conduct Sensitivity Analysis

The results presented in the Economic Potential Forecast are sensitive to the assumptions employed. Consequently, in consultation with Enbridge personnel, the Economic Potential results were subjected to a sensitivity analysis around two assumptions:

- **Technology Costs:** The Economic Potential Forecast was re-run using the most energy efficient technologies and measures assessed in Step 3, regardless of their current capital and installation costs (i.e., the most efficient technologies were included, even if they had a negative measure TRC value).[2] However, to ensure a measure of practical reality and basis for comparison with the preceding economic potential results, the technology adoption rates employed in this analysis are the same as those defined in the preceding economic potential forecast.

[2] In Enbridge's previous (2004) DSM Potential study, this analysis was reported as a separate Section entitled Technical Potential. The method and assumptions applied to current sensitivity analysis are the same as in the previous (2004) Technical Potential analysis.

- **Value of GHG Emissions**: The natural gas avoided cost values that were used to determine the measure TRC results presented in Step 4 do not include a value for greenhouse gas (GHG) emissions. However, the Government of Ontario has committed to aggressive GHG reduction targets. In this future context, it is not unreasonable to expect that future measure TRC calculations may incorporate a greenhouse gas (GHG) adder that accounts for carbon dioxide emissions resulting from natural gas consumption. Consequently, the measure TRC calculations were re-run using an avoided supply cost value that incorporates a GHG adder.

  The value of the GHG adder was set at \$15/tonne CO_2e (per tonne of CO_2 equivalent emissions) for the period 2007 to 2012 and \$20 /tonne CO_2e for the period 2013-2017. An emissions coefficient of 0.001903 tonnes CO_2e/m^3 (1903 g CO_2e/m^3) is used to account for carbon dioxide emissions resulting from natural gas consumption, while an emissions coefficient of 0.000220 tonnes CO_2e/kWh (220 g CO_2e/kWh) represents the average carbon dioxide emissions from electricity production in Ontario.[3, 4]

Step 6: Estimate Achievable Natural Gas Savings Potential

The Achievable Potential is the proportion of the savings identified in the Economic Potential Forecast that could realistically be achieved within the study period. The study assessed achievable natural gas savings potential from two perspectives:

- ***Potential Savings in Future Natural Gas Consumption:*** For this perspective, the study calculated the change in natural gas consumption levels that could occur in a given milestone year due to the aggregate impact of **all** measures implemented over the period from the Base Year (2007) to the Milestone Year (2012 or 2017). This perspective provides Enbridge Gas with an estimate of future natural gas consumption under different levels of DSM investment.

  This portion of the analysis calculated savings relative to the Reference Case (i.e., no new DSM), which is consistent with the approach used to estimate savings under the Economic Potential forecast and the sensitivity analyses described above in Steps 4 and 5.

- ***Potential DSM Program TRC Benefits***: For this perspective, the study calculated the potential natural gas savings in accordance with the provisions defined by the Ontario Energy Board (OEB) and employed by Enbridge when submitting its DSM plan to the OEB. This perspective emphasizes the estimation of net TRC benefits and the annual natural gas savings presented are due to those measures installed in (only) a given milestone year (i.e., 2012 or 2017).

[3] Based on emission factors and Global Warming Potentials (GWPs) presented in Environment Canada, National Inventory Report (1990-2005): Greenhouse Gas Sources and Sinks in Canada", pgs. 23 and 583, April 2007.

[4] Based on Ontario emission factors presented in Environment Canada, National Inventory Report (1990-2005): Greenhouse Gas Sources and Sinks in Canada", pg. 521, April 2007.

Within each of the above perspectives, the analysis of Achievable Potential was assessed under four different Marketing scenarios:

- One Financially Unconstrained scenario
- Three Financially Constrained scenarios, each limited by a different annual program budget, which for this study were set at $20 million, $40 million and $60 million.

Data on the costs and savings for each measure were combined with participation rates identified in the achievable workshops to generate measure-by-measure estimates of potential savings. These results were then compiled into a table and ranked according to TRC benefits per program dollar from least cost to most costly. From this table it was then possible to identify the most cost effective portfolio of measures at the $20 million, $40 million, $60 million and Financially Unconstrained budget levels together with the annual natural gas savings and net TRC benefits associated with each program budget level.[5]

The potential savings in future natural gas consumption were then calculated by selecting only those measures contained in the above table that passed at each budget level and milestone year. That package of measures was then applied in each of the sector models and the results were compared with those in the Reference Case and Economic Potential forecasts.

Further information on each of the Marketing scenarios is provided in each of the sector specific sections of this report.

1.5 STUDY ORGANIZATION AND REPORTS

The study was organized and conducted by sector using a common methodology, as outlined above. Following this introductory section, the remainder of this Synthesis Report is organized as follows:

- Section 2 presents the combined natural gas savings for the three sectors.
- Section 3 presents a summary of the natural gas savings for the Residential sector.
- Section 4 presents a summary of the natural gas savings for the Commercial sector.
- Section 5 presents a summary of the natural gas savings for the Industrial sector.

[5] There are numerous possible approaches to the selection of program measures; this approach was selected for simplicity and clarity.

2. SUMMARY OF STUDY FINDINGS

The study findings confirm the existence of significant remaining cost-effective natural gas DSM opportunities in the Residential, Commercial and Industrial sectors within Enbridge's service area.

2.1 TOTAL NATURAL GAS SAVING POTENTIAL

As presented previously in Section 1, the study estimated natural gas savings potential from two perspectives.

- **Potential Savings in Future Natural Gas Consumption –** This perspective estimates the reductions in future natural gas consumption based on the aggregate impact of DSM measures implemented over the study's 10-year time period.

- **Potential DSM Program TRC Benefits –** This perspective estimates the total lifetime savings due to those measures installed in (only) a given milestone year (i.e., 2012 or 2017). This is the method employed in the calculation of net TRC benefits and is part of the DSM program portfolio design process.

The savings associated with each perspective are summarized below.

2.1.1 Potential Savings in Future Natural Gas Consumption

Exhibits 2.1 and 2.2 provide a summary of the total annual natural gas consumption levels contained in each of the forecasts addressed by the study.[6]

Exhibits 2.3 and 2.4 provide a summary of the potential natural gas savings under each of the potential scenarios; in each case savings are presented in both volumetric (m^3) and percentage terms. In each case the savings shown are annual and are based on the aggregate impact of measures installed in prior years within the period when compared to the Reference Case consumption levels.

As illustrated in Exhibits 2.1 to 2.4, inclusive, Achievable Potential savings increase only marginally beyond the $40M scenario. Based on the Achievable Potential workshop results, few additional savings were identified in the $60M scenario and Financially Unconstrained scenarios, while maintaining a positive TRC.

[6] Note: Actual results may not be linear as shown in Exhibits 2.1 and 2.2.

Exhibit 2.1: Graphic of Forecast Results for the Total Enbridge Service Area – Annual Natural Gas Consumption

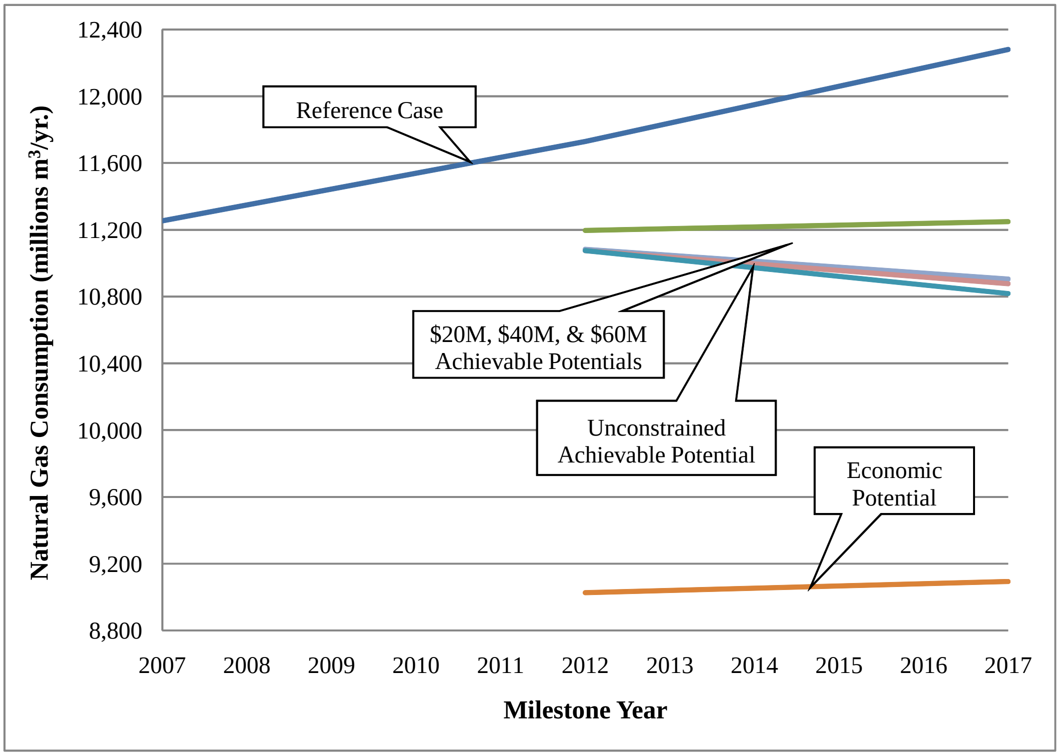


Exhibit 2.2: Total Annual Natural Gas Consumption, by Milestone Year and Forecast Scenario, 3 Sectors

Milestone Year	Total Annual Natural Gas Consumption, All Sectors (million m^3/yr.)					
	Reference Case	Economic Potential	Achievable Potential			
			$20M Scenario	$40M Scenario	$60M Scenario	Financially Unconstrained
2007	11,254					
2012	11,728	9,026	11,197	11,083	11,076	11,076
2017	12,280	9,093	11,249	10,905	10,877	10,818

Exhibit 2.3: Total Natural Gas Savings, in the Milestone Years and Forecast Scenario Relative to Reference Case and Economic Potential Forecasts, 3 Sectors

Milestone Year	Natural Gas Savings, All Sectors (million m^3/yr. vs. Ref Case, % vs. Ref. Case and Econ. Potential)				
	Economic Potential	Achievable Potential Scenarios			
		$20M Scenario	$40M Scenario	$60M Scenario	Financially Unconstrained
2012	2,703	532	645	652	652
2017	3,188	1,032	1,375	1,404	1,463
Savings as % of Reference Case Consumption					
2012	23%	5%	6%	6%	6%
2017	26%	8%	11%	11%	12%
Savings as % of Economic Potential Savings					
2012		20%	24%	24%	24%
2017		32%	43%	44%	46%

Note**:** Natural gas savings in the milestone years represent the potential reduction in gas use in that year as a result of DSM measures implemented in the period. Achievable Potential savings increase only marginally beyond the $40M scenario. Based on the Achievable Potential workshop results, few additional savings were identified in the $60M scenario and Financially Unconstrained scenarios, while maintaining a positive TRC.

Exhibit 2.4: Distribution of Natural Gas Savings, by Sector and Scenario in 2017, 3 Sectors

Sector	Natural Gas Savings, 2017 (million m^3/yr. vs. Ref Case, % of Econ. Potential Savings)				
	Economic Potential	Achievable Potential Scenarios			
		$20M Scenario	$40M Scenario	$60M Scenario	Financially Unconstrained
Residential	842	237	268	296	355
Commercial	1,427	440	715	715	715
Industrial	919	355	392	392	392
Total	3,188	1,032	1,375	1,404	1,463
Achievable Savings as % of Economic Potential Savings					
Residential		28%	32%	35%	42%
Commercial		31%	50%	50%	50%
Industrial		39%	43%	43%	43%
Total		32%	43%	44%	46%

Note**:** Natural gas savings in the milestone years represent the potential reduction in gas use in that year as a result of DSM measures implemented in the period. Achievable Potential savings increase only marginally beyond the $40M scenario. Based on the Achievable Potential workshop results, few additional savings were identified in the $60M scenario and Financially Unconstrained scenarios, while maintaining a positive TRC.

2.1.2 Potential DSM Program TRC Benefits

Exhibit 2.5 presents a summary of the forecast TRC benefits, annual program costs and natural gas savings in 2017 for each of the achievable scenarios, by scenario and sector. As noted previously, the natural gas savings shown in Exhibit 2.5 are calculated in accordance with OEB requirements for the filing of DSM plans. Therefore, the savings shown are only for the measures installed in 2017; they do not include the savings in 2017 that occur as a result of measures installed in prior years within the period.

Exhibit 2.5: Forecast Annual Achievable Program Costs[7], Savings[8] and TRC Benefits, by Scenario For Installations Completed in (only) 2017, 3 Sectors

Scenario	Forecast Achievable Program Costs and Savings, 2017				
	Annual Program Cost (millions $)	Gas Savings (million m^3/yr.)	TRC Benefits (million $)	Program Cost per Unit ($/$m^3$)	Program Cost per Unit ($/TRC$)
Residential (50% of Funding)					
$20M Annually	10.0	21.1	46.4	0.47	0.22
$40M Annually	20.0	27.0	47.2	0.74	0.42
$60M Annually	30.0	32.4	47.9	0.92	0.63
Financially Unconstrained	36.2	35.0	48.0	1.03	0.75
Commercial (30% of Funding)					
$20M Annually	6.0	48.9	168.1	0.12	0.04
$40M Annually	10.9	66.8	202.5	0.16	0.05
$60M Annually	10.9	66.8	202.5	*	*
Financially Unconstrained	10.9	66.8	202.5	*	*
Industrial (20% of Funding)					
$20M Annually	4.0	44.3	44.0	0.09	0.09
$40M Annually	4.4	48.0	44.3	0.09	0.10
$60M Annually	4.4	48.0	44.3	*	*
Financially Unconstrained	4.4	48.0	44.3	*	*
Total (3 Sectors)					
$20M Annually	20.0	114.3	258.5	0.18	0.08
$40M Annually	35.3	141.8	294.0	0.25	0.12
$60M Annually	45.3	147.3	294.7	**	**
Financially Unconstrained	51.5	149.8	294.8	**	**

** Based on the participation rates identified during the Achievable workshop results, all eligible measures are implemented at the program spending level shown.*
*** Values are not calculated as they are skewed by the Commercial and Industrial sector limits.*

2.2 OBSERVATIONS AND IMPLICATIONS

As illustrated in the preceding exhibits, despite a decade of successful DSM program implementation, there remains significant cost-effective DSM potential within Enbridge's service area. This remaining opportunity reflects, in part, continued technology cost and performance improvements over the period. Key study observations are highlighted below.

❑ Economic Potential

The study estimated economic potential savings to be approximately 3,188 million m^3 by 2017, which is approximately 26% relative to the Reference Case. This value is significantly larger than the value estimated in Enbridge's 2004 study; the change reflects a significant

[7] Program costs do not include salary and overhead costs.

[8] The savings shown in Exhibit 2.5 are only for the measures installed in 2017; they do not include the savings in 2017 that occur as a result of measures installed in prior years within the period.

increase in the Commercial sector savings opportunities, which is due to a combination of better information (that enabled better opportunity identification) and technology cost and performance improvements that widened the scope of technologies that passed the economic screen.

- **Achievable Potential Savings - Future Natural Gas Consumption**

Relative to the Reference Case forecast for 2017, the Achievable Potential savings range from about 1,375 million m^3 in the \$20 million scenario to approximately 1,463 m^3 in the Financially Unconstrained scenario, which represent 43% and 46%, respectively, of the economic potential savings.

In the residential and commercial sectors, two related factors contribute to the gap between the economic and achievable potential results. First, many of the energy efficiency measures are applicable as existing equipment turns over or new facilities are constructed. This means that during the first few years when programs were deemed to be in the start-up phase, a significant number of lost opportunities occur. Secondly, the study period is relatively short; hence, both the amount of stock turn-over that occurs in the period and the number of years to achieve results is shortened.

- **Potential DSM Program TRC Benefits**

TRC benefits, annual program costs and natural gas savings identified in this study remain in the same orders of magnitude as Enbridge's recent experience, with a general trend towards increasing costs per unit of gas savings.

- Residential sector program costs identified in this study under the \$20 million DSM scenario are \$0.47/m^3 as shown in Exhibit 2.5. This compares with 2007 actual costs that were in the range of \$0.32 (gross) to \$0.51 per m^3 (net).[9] Residential program costs per unit of gas savings and TRC benefits are significantly greater than in either the Commercial or Industrial sectors. This is also consistent with recent Enbridge results.

- Commercial sector program costs identified in this study under the \$20 million DSM scenario are \$0.12/m^3 as shown in Exhibit 2.5. This compares with 2007 actual costs that were in the range of \$0.14 (gross) to \$0.11 per m^3 (net). Commercial sector program costs per dollar of TRC benefits are the lowest among the three sectors; however, the sector runs out of cost-effective measures before reaching the limits set within the \$40 million or \$60 million scenarios. This situation reflects the views of the achievable workshop participants who indicated that participation rates in this sector were limited by market barriers, such as supply chain capacity, split incentives etc., that were particularly challenging.

- Industrial sector program costs identified in this study under the \$20 million DSM scenario are \$0.09/m^3 as shown in Exhibit 2.5. This compares with 2007 actual costs that were in the range of \$0.11 (gross) to \$0.06 per m^3 (net). Industrial sector program costs are also much lower per unit of gas savings and TRC benefits than in the

[9] Enbridge, 2007 LRAM Post Audit Results.

Residential sector. However, as in the Commercial sector, the Industrial sector also runs out of cost-effective measures before reaching the limits set within the $40 million or $60 million scenarios.

- **Key Technologies and Measures**

In the Residential sector, the measures that provide the most significant contribution to annual savings differ somewhat by milestone year. Measures that offer particularly significant natural gas savings potential in both milestone years include air sealing in older homes, programmable thermostats, and high-performance windows. Measures such as ultra low-flow showerheads provide large savings in 2012 but not in 2017 as they are assumed to have fully penetrated the market by 2017.

In the Commercial sector, recommissioning represents the largest contribution to annual savings in both milestone years. Other measures that offer particularly significant natural gas savings potential in both milestone years include hot water conservation measures and efficient new construction.

In the Industrial sector, three measure bundles provide particularly attractive savings opportunities. They are: upgrading to more efficient boilers and heaters, such as condensing boilers and direct contact hot water heaters; retrofitting ovens, dryers, kilns and furnaces to improve efficiency, such as exhaust gas heat recovery, high efficiency burners, insulation and advanced heating and process controls; and, system wide integrated control systems.

- **Key Markets and Trends**

As the DSM market matures within Enbridge's service area, niche or target markets are becoming increasingly important. Measures that may not pass the TRC test in a "typical" or "average" application often will pass in niche applications. For example:

- Air sealing and insulation in older homes (built before 1980) is one example that was included in this study, as data were available. Similarly, additional domestic hot water measures may be feasible in homes with a larger number of occupants. For example, drain water heat recovery systems and DHW recirculation systems become more economically attractive with larger household sizes. These latter measures have not been included in the current results as suitable data were not available.

Similarly, the sector specific results presented in the following sections indicate that market transformation approaches warrant additional consideration, particularly in the Residential and Commercial sectors. Alternately, opportunities such as those listed below suggest that the composition of the TRC calculation itself may need to be revisited to better consider non-energy benefits. For example:

- In the Residential sector, the technology cost sensitivity analysis showed that there remains an additional untapped potential savings by 2017 of about 1,100 million m^3 from technically mature measures that do not currently pass the TRC screen. The largest share of these additional potential savings is from air sealing and envelope insulation in existing homes. These measures do not pass the TRC screen as currently defined.

However, they provide non-energy benefits such as increased comfort and reduced noise that are not currently captured in the TRC calculation. In addition, industry specialists emphasized that as insulation levels increase, proper air and moisture sealing is becoming increasingly essential to the long-term structural integrity of Ontario's housing stock. This situation presents both an opportunity and a possible technical issue that may be better addressed through a market transformation approach.

- In the Commercial sector, the technology cost sensitivity analysis showed that there remains an additional untapped potential savings by 2017 of about 269 million m^3 from technically mature measures that do not currently pass the TRC screen. The largest share of these additional potential savings are from air sealing and envelope upgrades, including wall insulation and more energy efficient glazing measures in existing buildings. These measures do not pass the TRC screen as currently defined. However, as in the residential sector, the measures provide non-energy benefits such as increased comfort and reduced noise that are not currently captured in the TRC calculation.

In addition, industry specialists emphasized that some emerging technologies, such as solar preheated make-up air may be better addressed in a market transformation context, as they provide "soft" benefits, such as visible contribution to corporate greening goals, which are not included in the TRC calculation.

3. RESIDENTIAL SECTOR

The Residential sector includes single-family detached homes, attached duplex, row and multi-family dwellings and apartments as well as a small number of other dwellings.

3.1 APPROACH

The detailed end-use analysis of energy efficiency opportunities in the Residential sector employed two linked modelling platforms: **HOT2000,** a commercially-supported residential building energy-use simulation software, and **RSEEM** (Residential Sector Energy End-use Model), a Marbek in-house spreadsheet-based macro model.

The major steps in the general approach to the study are outlined in Section 1.4 above (Approach). Specific procedures for the Residential sector were as follows:

- **Modelling of Base Year –** The consultants used the Enbridge customer data to break down the Residential sector by four factors:

  - Type of dwelling (single detached, attached, apartment, etc.)
  - Heating category (natural gas or electric heat)
  - The age of the building
  - Service region.

  To estimate the natural gas used for space heating, the consultants factored in building characteristics such as insulation levels, floor space and air tightness using a variety of data sources, including the Ontario Energuide for Houses database, Enbridge billing data, local climate data and discussions with local contractors. They also used the results of Enbridge customer surveys that provided data on type of heating system, number and age of household appliances, renovation activity, etc. Based on the available data sources, the consultants calculated an average natural gas use by end use for each dwelling type. The consultant's models produced a close match with actual Enbridge sales data.

- **Reference Case Calculations -** For the Residential sector, the consultants developed profiles of new buildings for each type of dwelling. They estimated the growth in building stock using the same data as that contained in the Enbridge most recent load forecast and estimated the amount of natural gas used by both the existing building stock and the projected new buildings and appliances. As with the Base Year calibration, the consultants' projection closely matches Enbridge's own 2007 forecast of future Natural gas requirements.

- **Assessment of DSM Measures –** To estimate the economic and achievable energy savings potentials, the consultants assessed a wide range of commercially available energy efficiency measures and technologies such as:
  - Thermal upgrades to the walls, roofs and windows of existing buildings
  - More efficient space heating equipment and controls
  - Measures to reduce hot water usage
  - Improved designs for new buildings
  - Addition of solar thermal technologies.

3.2 RESIDENTIAL NATURAL GAS SAVINGS POTENTIAL

A summary of the levels of annual natural gas consumption and potential natural gas savings contained in each of the Residential sector forecasts addressed by the study are presented in Exhibits 3.1 to 3.3, and are discussed briefly in the sub sections that follows.

Exhibit 3.1: Graphic of Forecast Results for the Total Enbridge Service Area – Annual Natural Gas Consumption, Residential Sector (million m^3/yr.)

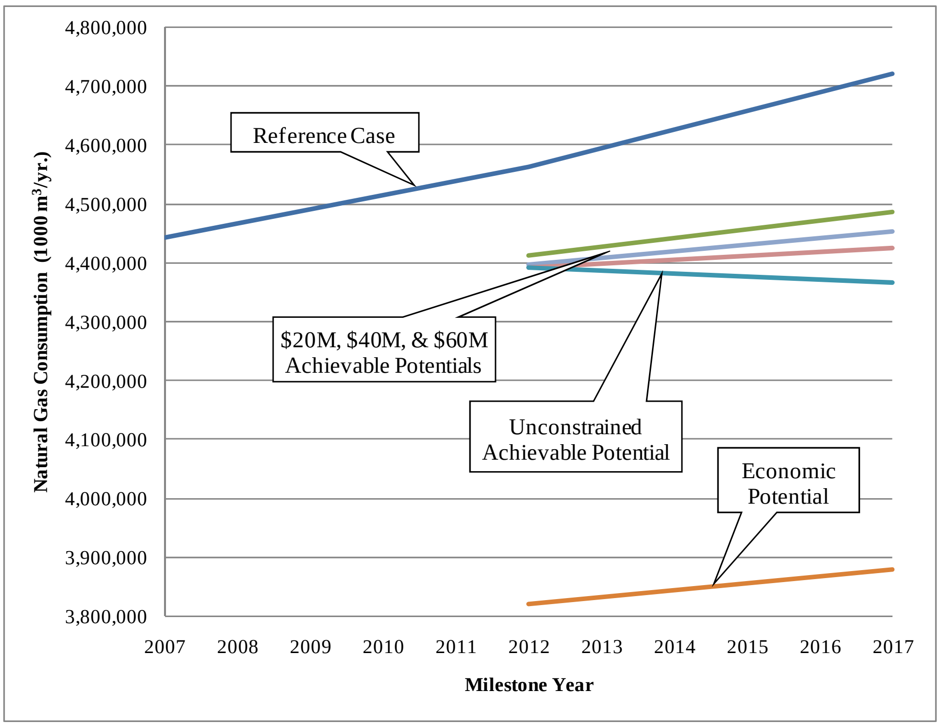


Exhibit 3.2: Summary of Forecast Results for the Total Enbridge Service Area – Annual Natural Gas Consumption, Residential Sector (million m^3/yr.)

Milestone Year	Annual Consumption in Residential Sector (million m^3/yr.)					
	Reference Case	Economic Potential	Achievable Potential			
			$20M Scenario	$40M Scenario	$60M Scenario	Financially Unconstrained
2007	4,442					
2012	4,563	3,820	4,413	4,399	4,392	4,392
2017	4,722	3,880	4,486	4,455	4,426	4,367

Exhibit 3.3: Summary of Forecast Results for the Total Enbridge Service Area – Natural Gas Savings in Milestone Years, Residential Sector (million m^3/yr. and % Relative to Economic Potential Scenario)

Milestone Year	Natural Gas Savings (million m^3/yr. Relative to Ref Case, % Relative to Economic Potential)				
	Economic Potential	Achievable Potential			
		$20M Scenario	$40M Scenario	$60M Scenario	Financially Unconstrained
2012	743	150	165	172	172
2017	842	237	268	296	355
2012		20%	22%	23%	23%
2017		28%	32%	35%	42%

Note**:** Natural gas savings in the milestone years represent the potential reduction in gas use in that year as a result of DSM measures implemented in the period.

3.3 BASE YEAR NATURAL GAS USE

In the Base Year of 2007, the Residential sector in Enbridge's total service area consumed about 4,442,437,000 m^3. Exhibit 3.4 shows that approximately 80% of the natural gas consumption in the residential sector occurs in the Single Family Detached dwellings, and of this amount, the pre-1980 vintage accounts for about 60%. The Duplex/Row/Multi category of housing accounts for approximately 11% of residential natural gas consumption, while Mobile/Other housing accounts for the remaining 9%.

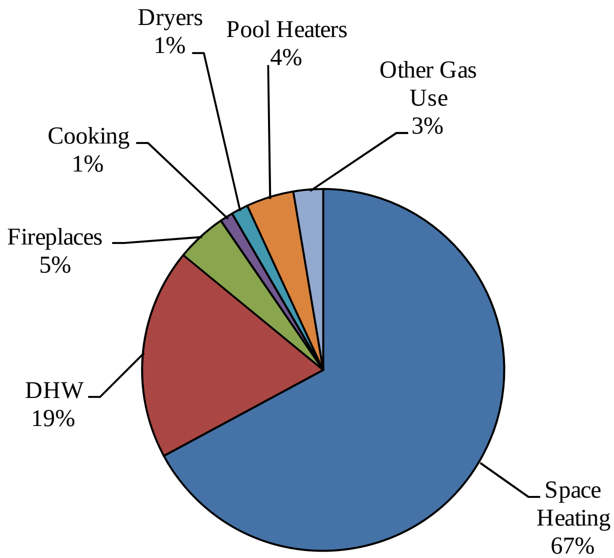
The Central Service region accounts for nearly 80% of the residential natural gas consumption in the Enbridge Gas Service Area.

Exhibit 3.4: Base Year Residential Sector Natural Gas Use for the Total Enbridge Service Area (1000 m^3/yr)

Segment	Space Heating	DHW	Fireplaces	Cooking	Dryers	Pool Heaters	Other Gas Use	Totals
	1000 m^3/yr.	1000 m^3/yr.	1000 m^3/yr.	1000 m^3/yr.	1000 m^3/yr.	1000 m^3/yr.	1000 m^3/yr.	1000 m^3/yr.
Detached - without gas space heat		16,301	6,310	998	1,326	4,602	2,274	31,812
Detached - pre-1980s	1,519,765	333,235	66,771	22,360	28,196	95,809	47,371	2,113,507
Detached - 1981 to 1993	387,972	133,595	37,598	7,401	10,165	52,379	18,177	647,287
Detached - 1993 to Present	431,296	155,765	64,147	10,478	13,958	35,210	21,556	732,409
Duplex/Row/Multi - no space htg		3,017	503	158	196		436	4,311
Duplex/Row/Multi - pre-1980s	243,499	53,418	4,672	2,996	3,553		7,711	315,849
Duplex/Row/Multi - 1980 or newer	160,787	64,827	10,058	3,383	4,249		9,068	252,372
Other	243,553	73,155	9,174	3,914	4,746		10,347	344,891
TOTAL	2,986,872	833,314	199,234	51,688	66,389	188,000	116,940	4,442,437

As illustrated in Exhibit 3.5 space heating accounts for about 67% of total residential natural gas use. Domestic hot water (DHW) accounts for about 19% of the total natural gas use, followed by fireplaces (5%) and pool heaters (4%). Dryers, cooking ranges and selected other uses, such as barbeques and patio heaters, account for the remaining natural gas consumption.

Exhibit 3.5: Base Year Residential Sector Natural Gas Use for the Total Enbridge Gas Service Area, by End Use



3.4 REFERENCE CASE

In the absence of new DSM initiatives, the study estimates that natural gas consumption in the Residential sector will grow from 4,442,437,000 m$^{3/}$yr in 2007 to about 4,772,205 m$^{3/}$yr in 2017. This represents an overall growth of about 7.4% in the period and compares very closely with Enbridge‘s own forecast, which also includes consideration of the impacts of "natural conservation."

Exhibit 3.6 (overleaf) shows the forecast levels of Residential sector natural gas consumption for the entire Enbridge service area. The results are presented for each milestone year and end use.

Exhibit 3.6: Residential Sector Reference Case Natural Gas Use for the Total Enbridge Service Area, by Dwelling Type, End use and Milestone Year (1000 m^3/yr)

Dwelling Type	Milestone Year	Residential							
		Total	Space Heating	DHW	Fireplaces	Cooking	Dryers	Pool Heaters	Other Gas Use
Detached - without gas space heat	2007	31,812	0	16,301	6,310	998	1,326	4,602	2,274
	2012	32,174	0	16,571	5,728	1,065	1,413	4,951	2,446
	2017	32,625	0	16,777	5,348	1,126	1,493	5,275	2,606
Detached - pre-1980s	2007	2,113,507	1,519,765	333,235	66,771	22,360	28,196	95,809	47,371
	2012	2,007,253	1,440,802	316,074	57,232	22,180	27,785	95,809	47,371
	2017	1,936,122	1,394,135	299,192	50,078	22,002	27,535	95,809	47,371
Detached - 1981 to 1993	2007	647,287	387,972	133,595	37,598	7,401	10,165	52,379	18,177
	2012	615,655	367,814	126,715	32,227	7,341	11,002	52,379	18,177
	2017	592,787	355,900	119,947	28,198	7,282	10,903	52,379	18,177
Detached - 1993 to Present	2007	732,409	431,296	155,765	64,147	10,478	13,958	35,210	21,556
	2012	885,149	521,900	190,506	68,062	13,545	17,018	45,972	28,147
	2017	1,018,378	595,486	222,344	73,340	16,389	20,576	55,971	34,271
Duplex/Row/Multi - no space htg	2007	4,311	0	3,017	503	158	196	0	436
	2012	5,317	0	3,739	540	207	254	0	577
	2017	6,507	0	4,577	609	263	322	0	736
Duplex/Row/Multi - pre-1980s	2007	315,849	243,499	53,418	4,672	2,996	3,553	0	7,711
	2012	299,608	230,848	50,667	4,005	2,972	3,406	0	7,711
	2017	288,870	223,371	47,961	3,504	2,948	3,376	0	7,711
Duplex/Row/Multi - 1980 or newer	2007	252,372	160,787	64,827	10,058	3,383	4,249	0	9,068
	2012	370,211	234,735	96,261	12,628	5,344	6,758	0	14,486
	2017	494,219	308,157	132,258	16,077	7,563	9,558	0	20,606
Other	2007	344,891	243,553	73,155	9,174	3,914	4,746	0	10,347
	2012	347,865	244,816	74,359	8,327	4,181	5,051	0	11,131
	2017	352,699	248,030	75,272	7,774	4,428	5,336	0	11,858
TOTAL	2007	4,442,437	2,986,872	833,314	199,234	51,688	66,389	188,000	116,940
	2012	4,563,233	3,040,914	874,892	188,748	56,835	72,687	199,111	130,046
	2017	4,722,205	3,125,079	918,328	184,928	62,000	79,099	209,434	143,337

3.5 ASSESSMENT OF ENERGY EFFICIENCY MEASURES

The study assessed a total of approximately 50 potential energy efficiency measures. A summary of the screening results for the energy-efficiency measures is presented in Exhibit 3.7. Due to the number of measures assessed, Exhibit 3.7 shows only the results for those options that pass the screen in the Central service region.

Exhibit 3.7: Summary of Measure TRC Screening Results Residential Sector Energy-efficiency Options – Central Region

Measure	Measure Description	Full/Incr.	Simple Payback (Years)	Measure TRC ($)	Benefit/Cost Ratio
Ceiling Insulation	Attached (Existing)	Full	7.5	$17	1.04
High-Performance Windows (ENERGY STAR®)	Single Detached (Existing)	Incr.	6.0	$148	1.30
High-Performance Windows (ENERGY STAR®)	Attached (Existing)	Incr.	4.1	$304	1.87
High-Performance Windows (ENERGY STAR®)	Single Detached (New)	Incr.	3.6	$371	2.24
High-Performance Windows (ENERGY STAR®)	Attached (New)	Incr.	2.4	$445	3.23
Super High-Performance Windows	Single Detached (Existing)	Incr.	7.7	$22	1.02
Super High-Performance Windows	Attached (Existing)	Incr.	6.5	$141	1.20
Super High-Performance Windows	Single Detached (New)	Incr.	5.4	$281	1.47
Super High-Performance Windows	Attached (New)	Incr.	3.6	$460	2.15
Air Sealing and Insulation (Old Homes)	Single Detached (Existing)	Full	7.5	$58	1.03
Air Sealing and Insulation (Old Homes)	Attached (Existing)	Full	7.4	$67	1.04
Programmable Thermostats	Single Detached (Existing)	Full	0.5	$502	11.04
Programmable Thermostats	Attached (Existing)	Full	0.6	$442	9.84
Programmable Thermostats	Single Detached (New)	Incr.	0.7	$359	8.18
Programmable Thermostats	Attached (New)	Incr.	0.8	$313	7.27
Solar Orphans Program	Single Detached (Existing)	Full	3.9	$47	1.09
Solar Orphans Program	Attached (Existing)	Full	4.1	$29	1.06
High-Efficiency Fireplaces	Single Detached (Existing)	Incr.	2.4	$133	2.33
High-Efficiency Fireplaces	Attached (Existing)	Incr.	3.3	$65	1.65
High-Efficiency Fireplaces	Single Detached (New)	Incr.	3.5	$56	1.56
High-Efficiency Fireplaces	Attached (New)	Incr.	5.0	$10	1.10
Solar Preheated Make-Up Air	Single Detached (Existing)	Full	5.5	$214	1.16
Solar Preheated Make-Up Air	Attached (Existing)	Full	6.1	$66	1.05
Ultra Low-Flow Showerheads	Single Detached (Existing)	Full	0.2	$246	17.38
Ultra Low-Flow Showerheads	Attached (Existing)	Full	0.3	$215	15.31
Ultra Low-Flow Showerheads	Single Detached (New)	Full	0.3	$230	16.36
Ultra Low-Flow Showerheads	Attached (New)	Full	0.3	$200	14.32
Hot Water Pipe Insulation	Single Detached (Existing)	Full	0.1	$47	48.12
Hot Water Pipe Insulation	Attached (Existing)	Full	0.1	$46	46.52
DHW Temperature Reduction	Single Detached (Existing)	Full	0.0	$27	N/A
DHW Temperature Reduction	Attached (Existing)	Full	0.0	$26	N/A
Efficient Top Loading Clothes Washers	Single Detached (Existing)	Incr.	2.4	$315	2.26
Efficient Top Loading Clothes Washers	Attached (Existing)	Incr.	2.6	$259	2.03
Efficient Top Loading Clothes Washers	Single Detached (New)	Incr.	2.5	$289	2.16
Efficient Top Loading Clothes Washers	Attached (New)	Incr.	2.8	$234	1.94
Efficient Dishwashers	Single Detached (Existing)	Incr.	1.4	$125	3.50
Efficient Dishwashers	Attached (Existing)	Incr.	1.5	$114	3.29

Measure	Measure Description	Full/Incr.	Simple Payback (Years)	Measure TRC ($)	Benefit/Cost Ratio
Efficient Dishwashers	Single Detached (New)	Incr.	1.5	$111	3.22
Efficient Dishwashers	Attached (New)	Incr.	1.6	$101	3.01
Efficient Front Loading Clothes Washers	Single Detached (Existing)	Incr.	4.2	$141	1.28
Efficient Front Loading Clothes Washers	Attached (Existing)	Incr.	4.6	$79	1.16
Efficient Front Loading Clothes Washers	Single Detached (New)	Incr.	4.4	$111	1.22
Efficient Front Loading Clothes Washers	Attached (New)	Incr.	4.9	$51	1.10
Swimming Pool Covers	Single Detached (Existing)	Full	2.6	$833	1.69
Swimming Pool Covers	Single Detached (New)	Full	2.6	$833	1.69
Solar Pool Heaters	Single Detached (Existing)	Full	1.8	$4,824	3.61
Solar Pool Heaters	Single Detached (New)	Full	1.8	$4,824	3.61

3.6 ECONOMIC POTENTIAL FORECAST

Under the conditions of the Economic Potential Forecast,[10] the study estimated that natural gas consumption in the Residential sector would decline to about 3,880 million $m^{3/}$yr by 2017 for the total Enbridge service area. Annual savings relative to the Reference Case are about 842 million $m^{3/}$yr by 2017, or about 18%. Further details are provided in Exhibits 3.8 and 3.9, which show the results for both milestone years by dwelling type and end use, respectively.

Exhibit 3.8: Natural Gas Savings for the Total Enbridge Service Area by Dwelling Type and Milestone Year, Reference Case vs. Economic Potential (1000 m^3/yr.)

Dwelling Type	Milestone Year		% Savings 2017	
	2012	2017	Re: Ref Case	Re: Total
	1000 m^3/yr.			
Detached - without gas space heat	7,861	9,463	29%	1%
Detached - pre-1980s	401,529	417,743	22%	50%
Detached - 1981 to 1993	89,071	98,928	17%	12%
Detached - 1993 to Present	117,434	155,442	15%	18%
Duplex/Row/Multi - no space htg	989	1,521	23%	0%
Duplex/Row/Multi - pre-1980s	52,851	55,330	19%	7%
Duplex/Row/Multi - 1980 or newer	45,322	67,309	14%	8%
Other	28,303	36,159	10%	4%
Total	743,361	841,895	18%	100%

Note: Any difference in totals is due to rounding.

[10] The level of natural gas consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost-effective. In this study, "cost-effective" means that the technology upgrade passes the measure Total Resource Cost (TRC) test, as discussed previously in Section 1.4.

Exhibit 3.9: Natural Gas Savings for the Total Enbridge Service Area by End Use and Milestone Year, Reference Case vs. Economic Potential (1000 m^3/yr.)

End Use	**Milestone Year**		**% Savings 2017**	
	2012	**2017**	**Re: Ref Case**	**Re: Total**
	1000 m^3/yr.			
Space Heating	374,454	385,062	12%	46%
DHW	207,214	278,239	30%	33%
Fireplaces	5,413	9,805	5%	1%
Dryers	8,759	17,403	22%	2%
Pool Heaters	147,521	151,387	72%	18%
Total	743,361	841,895	18%	100%

Note: DHW savings include savings from reduced DHW consumption by efficient clothes washers and dishwashers. Any difference in totals is due to rounding.

3.6.1 Sensitivity Analysis

The Economic Potential results were subjected to a sensitivity analysis around two of the assumptions employed: Technology Cost and inclusion of a value for GHG emissions (as described in Step 5, in Section 1.4). The two sensitivity analyses offer the following insights:

- In the residential sector, there are a substantial number of measures that do not currently pass the economic screen but do offer substantial additional savings potential. Most of these measures provide improved thermal performance in existing dwellings.

  The Technology Cost sensitivity analysis identified potential savings of about 1,907 million m^3 in 2017; this compares with identified savings potential of about 734 million m^3 in 2017 under the Economic Potential forecast. Hence, the identified Technical savings potential is about a 2.6 times that identified in the Economic Potential forecast.

- The GHG adder makes a relatively small difference to the overall avoided cost of energy, and therefore, only a few additional measures pass the economic screen. Potential savings are increased by only a modest amount.

3.7 ACHIEVABLE POTENTIAL

As noted previously, Achievable Potential was assessed from two perspectives:

- Potential Savings in Future Natural Gas Consumption: Savings in one year due to the aggregate impact of measures implemented over the time period of Base Year (2007) to Milestone Year (2012 and 2017). This method calculates the net change in future natural gas supply requirements.

- Potential DSM Program TRC Benefits.[11] Savings due to (only) those measures implemented in one year. This method is used in calculation of the net TRC benefits.

Within each of the above perspectives, the analysis of Achievable Potential was assessed under four different Marketing scenarios:

- One Financially Unconstrained scenario
- Three Financially Constrained scenarios, each limited by a different level of program budget availability.

Further detail related to each of the Marketing scenarios is provided below followed by a summary of results.

3.7.1 Financially Unconstrained DSM Marketing Scenario

The Financially Unconstrained scenario provides an overview of the level of potential natural gas savings that could be achieved if a comprehensive portfolio of DSM programs was launched without any constraint on the availability of program funding, except for the requirement to maintain a positive TRC.

Although the results of this scenario are not constrained by program funding, the results do incorporate consideration of the market constraints identified during the Achievable Potential workshop, such as product and service availability and customer transaction costs.

This scenario, therefore, provides a high-level estimate of the upper level of natural gas savings that could be achieved by Enbridge's residential customers over the nine-year period beginning in 2009 and ending in 2017. It also provides Enbridge's residential DSM program personnel with a view of the relative potential contribution of individual sub sectors, end uses, technologies and service regions.

[11] The annual savings presented do not explicitly address the potential impact of free riders at the level of individual program measure. However, the Reference Case 3 does include an estimate of the impact of natural conservation over the study period, by end use (i.e., an estimate of natural gas savings that would occur in the absence of additional Enbridge DSM programs). Hence, the inclusion of natural conservation in the study's Reference Case does address some, but not necessarily all, free rider and spillover impacts. A more detailed assessment of free rider and spillover impacts is practical only as part of a detailed program design, which is beyond the scope of this study.

Major Assumptions: Financially Unconstrained Scenario

- All measures that pass the measure TRC screen are included
- No program financial limit is set, except that all measures must continue to pass the measure TRC screen
- Participation rates for each measure are based on the workshop results, which consider both market barriers and potential promotional strategies.

Exhibit 3.10 provides details on the program costs assumed for each measure.

Exhibit 3.10: Summary of Program Cost Assumptions, Financially Unconstrained Scenario[12]

Upgrade Technology/Measures	Fixed Program Costs ($/yr.)	Measure Basis	Measure Cost ($)[A]	Incentive Level (% of cost)	Payback After Incentive (yrs.)
High-Performance Windows	25,000	Incr.	500	100%	0.0
Super High-Performance Windows	25,000	Incr.	950	100%	0.0
Air Sealing and Insulation (Old Homes)	75,000	Full	2,000	45%	4.1
Attic/Ceiling Insulation		Full	600	45%	4.8
Programmable Thermostats	60,000	Full	50	36%	0.3
Solar Pre-Heated Make-Up Air	75,000	Full	1,300	75%	1.4
Ultra Low-Flow Showerheads	40,000	Full	15	100%	0.0
Efficient Dishwashers	30,000	Incr.	50	100%	0.0
Efficient Top Loading Clothes Washers		Incr.	250	40%	1.4
Efficient Front Loading Clothes Washers		Incr.	500	20%	3.3
DHW Temperature Reduction	50,000	Full	N/A	100%	0.0
Hot Water Pipe Insulation	1,000	Full	1	0%	0.1
High-Efficiency Fireplaces	50,000	Incr.	100	15%	2.0
Swimming Pool Covers	30,000	Full	1,200	5%	2.4
Solar Pool Heaters		Full	1,850	5%	1.7
Solar Orphans Program	20,000	Full	500	18%	3.2

[A] Where measure cost varies by region and/or housing type, the cost for existing single detached homes in the Central service region is shown

3.7.2 Financially Constrained DSM Marketing Scenarios

These DSM scenarios provide estimates of the potential impacts of increasingly larger annual DSM budgets that, as noted previously, were set at $20, $40 and $60 million annually. Within each of these budgets, 50% of the funding is allocated to the Residential sector for the purposes of this analysis; thus, the annual Residential sector budgets are $10, $20 and $30 million annually.

The Financially Constrained scenarios include the following DSM costs:

[12] Salary and related overhead costs are not included in program cost estimates. Also, the incentive levels are capped at 100% of the indicated measure cost.

- **Fixed Program Costs:** This includes costs for items such as newspaper advertisement, preparation of information and marketing materials, training workshops, contractor certifications, etc. These are program cost elements that would not be expected to vary significantly if the number of installations of the measure changed. Estimates for these cost items were provided by Enbridge personnel based on current and previous experience with similar DSM measures. In each case, these costs are expressed as dollars of program spending per year. Salary and related overhead costs are not included.

- **Incentive Costs:** These costs would include any costs that vary directly according to the number of installations of the measure. In each case, these costs are expressed as a percentage of the installed cost of the measure.

Exhibit 3.11 provides details on the program costs assumed for each measure.

Exhibit 3.11: Summary of Program Cost Assumptions, Financially Constrained Scenarios[13]

Upgrade Technology/Measures	Fixed Program Costs ($/yr.)	Measure Basis	Measure Cost ($)[A]	Incentive Level (% of cost)	Payback After Incentive (yrs.)
High-Performance Windows	25,000	Incr.	500	100%	0.0
Super High-Performance Windows	25,000	Incr.	950	100%	0.0
Air Sealing and Insulation (Old Homes)	75,000	Full	2,000	25%	5.6
Attic/Ceiling Insulation		Full	600	25%	6.5
Programmable Thermostats	60,000	Full	50	21%	0.4
Solar Pre-Heated Make-Up Air	75,000	Full	1,300	25%	4.1
Ultra Low-Flow Showerheads	40,000	Full	15	100%	0.0
Efficient Dishwashers	15,000	Incr.	50	100%	0.0
Efficient Top Loading Clothes Washers		Incr.	250	30%	1.6
Efficient Front Loading Clothes Washers		Incr.	500	15%	3.5
DHW Temperature Reduction	50,000	Full	N/A	100%	0.0
Hot Water Pipe Insulation	1,000	Full	1	0%	0.1
High-Efficiency Fireplaces	30,000	Incr.	100	10%	2.1
Swimming Pool Covers	10,000	Full	1,200	3%	2.5
Solar Pool Heaters		Full	1,850	3%	1.7
Solar Orphans Program	7,000	Full	500	18%	3.2

[A] Where measure cost varies by region and/or housing type, the cost for existing single detached homes in the Central service region is shown

[13] Salary and related overhead costs are not included in program cost estimates. Also, the incentive levels are capped at 100% of the indicated measure cost.

3.7.3 Achievable Potential Savings - Future Natural Gas Consumption[14]

Exhibits 3.12 to 3.14, inclusive, present a summary of the Achievable Potential savings in future natural gas consumption relative to the Reference Case levels. For illustration, the results of the Financially Unconstrained scenario are shown. Selected highlights are provided below.

- Exhibit 3.12 shows that total Residential sector natural gas savings in 2017 are estimated to be approximately 355 million m^3/yr. This represents a savings of approximately 8%, relative to the Reference Case and is equal to approximately 42% of the savings identified in the Economic Potential Forecast. The Central service region accounts for about 83% of the identified potential. In this scenario, the rate of introduction of full cost measures is limited by market constraints; as a result the potential savings in 2012 were estimated to be approximately 172 million m^3/yr., or about 23% of the savings identified in the Economic Potential Forecast, where full cost measures are introduced immediately.

- Exhibit 3.13 shows the results by dwelling type. As illustrated, single-family detached dwellings account for nearly 80% of the identified potential and over 60% of these potential savings are in dwellings built prior to 1980.

- Exhibit 3.14 shows the results by end use. As illustrated, measures that reduce space heating and domestic hot water loads account for approximately 87% of the identified potential, followed by pool heaters (10%), fireplaces (1%) and clothes dryers (1%). Additional detail on the specific measures that contribute to these end-use savings is provided in the following sections.

Exhibit 3.12: Natural Gas Savings by Service Region and Milestone Year, Financially Unconstrained Scenario (1000 m^3/yr.)

Milestone Year	Central Region	Eastern Region	Total	% Savings Relative to Ref Case
	1000 m^3/yr.			
2012	139,540	32,190	171,730	4%
2017	295,727	59,429	355,156	8%
% Savings 2017 Re: Reference Case	8%	6%	8%	
% Savings 2017 Re: Total	83%	17%	100%	

Note: Any difference in totals is due to rounding.

[14] See definition of savings as provided in Step 6, page 7.

Exhibit 3.13: Natural Gas Savings by Dwelling Type and Milestone Year for the Total Enbridge Service Area, Financially Unconstrained Scenario (1000 m^3/yr.)

Dwelling Type	Milestone Year		% Savings 2017	
	2012	2017	Re: Ref Case	Re: Total
	1000 m^3/yr.			
Detached - without gas space heat	1,953	3,377	10%	1%
Detached - pre-1980s	75,646	168,649	9%	47%
Detached - 1981 to 1993	21,456	38,739	7%	11%
Detached - 1993 to Present	34,633	67,577	7%	19%
Duplex/Row/Multi - no space htg	392	735	11%	0%
Duplex/Row/Multi - pre-1980s	10,222	22,395	8%	6%
Duplex/Row/Multi - 1980 or newer	16,649	34,500	7%	10%
Other	10,779	19,184	5%	5%
Total	171,730	355,156	8%	100%

Exhibit 3.14: Natural Gas Savings by End Use and Milestone Year for the Total Enbridge Service Area, Financially Unconstrained Scenario (1000 m^3/yr.)

End Use	Milestone Year		% Savings 2017	
	2012	2017	Re: Ref Case	Re: Total
	1000 m^3/yr.			
Space Heating	72,598	182,794	6%	51%
DHW	78,910	128,798	14%	36%
Fireplaces	1,497	3,931	2%	1%
Dryers	876	2,605	3%	1%
Pool Heaters	17,849	37,028	18%	10%
Total	171,730	355,156	8%	100%

Note: DHW savings include savings from reduced DHW consumption by efficient clothes washers and dishwashers. Any difference in totals is due to rounding.

3.7.4 Potential DSM Program TRC Benefits

Exhibits 3:15, 3.16 and 3.17 present the results for the milestone year 2017. As illustrated, annual Residential sector program spending of approximately $10 million in 2017 would result in the installation of measures providing approximately 21 million m^3/year in natural gas savings[15] and approximately $46 million in TRC net benefits. The exhibits also illustrate that even under the conditions defined by the Financially Unconstrained scenario, the Residential sector runs out of eligible cost-effective measures. Additional details are provided in the following exhibits.

- Exhibit 3.15 presents the 2017 results by upgrade technology or measure, including both the Current Marketing Level of customer participation and the increment from the Current Marketing Level to the Financially Unconstrained Marketing scenario. For each measure, annual natural gas savings potential, net TRC benefits and annual program costs are presented both individually and cumulatively. The measures are sorted in order of increasing program cost per dollar of TRC benefits. The 10

15 Note: the savings shown are only for the measures installed in 2017; they do not include the savings in 2017 that occur as a result of measures installed in prior periods.

measures contributing the most TRC benefits are assigned letters, matching the labels on Exhibits 3.14 and 3.15.

- Exhibit 3.16 presents the 2017 results graphically, with program costs on the vertical axis and net TRC benefits on the horizontal axis. All of the measures that pass the measure TRC screen are included here but balloons are added to indicate the location of the top ten measures (in terms of TRC benefits) on the curve. Three annual budget levels for residential program spending are shown as horizontal lines, for reference.

- Exhibit 3.17 presents the 2017 results graphically, with program costs on the vertical axis and annual natural gas savings potential on the horizontal axis. As with Exhibit 3.16, all of the measures which are included in the Achievable Potential analysis are shown here and balloons are added to indicate the positions of substantial measures on the curve. Sorting of the measures is based on program costs per unit TRC benefit.

Exhibit 3.15: Summary of 2017 Achievable Results** by Measure, for the Total Enbridge Service Area

Reference (Marked on Graphs)	Upgrade Technology/Measures	Scenario	Annual Natural Gas Savings Potential (1000 m³/yr.)		Net TRC Benefits ($)		Annual Program Costs ($)		Program Costs per Unit	
				Cumulative		Cumulative		Cumulative	per Natural Gas Savings ($/m³)	per TRC Benefits ($/$)
	DHW Temperature Reduction	F. Unconstrained	7	7	$ 11,550	$ 11,550	$ -	$ -	N/A	N/A
A	Hot Water Pipe Insulation	F. Unconstrained	217	224	$ 560,411	$ 571,961	$ -	$ -	N/A	N/A
B	Hot Water Pipe Insulation	CML	1055	1,278	$ 2,718,359	$ 3,290,319	$ 1,000	$ 1,000	0.00	0.00
C	Solar Pool Heaters	CML	1877	3,156	$ 4,345,334	$ 7,635,653	$ 67,109	$ 68,109	0.04	0.02
D	Programmable Thermostats	CML	6902	10,058	$ 18,841,740	$ 26,477,393	$ 488,114	$ 556,223	0.07	0.03
E	Solar Pool Heaters	F. Unconstrained	3349	13,407	$ 8,068,567	$ 34,545,960	$ 213,392	$ 769,615	0.06	0.03
	Swimming Pool Covers	CML	49	13,457	$ 46,707	$ 34,592,667	$ 2,327	$ 771,942	0.05	0.05
	Swimming Pool Covers	F. Unconstrained	46	13,503	$ 47,735	$ 34,640,402	$ 4,728	$ 776,670	0.10	0.10
F	Programmable Thermostats	F. Unconstrained	1330	14,832	$ 3,650,170	$ 38,290,572	$ 417,087	$ 1,193,757	0.31	0.11
G	Efficient Top-Loading Clothes Washers	CML	1479	16,311	$ 3,272,110	$ 41,562,682	$ 532,910	$ 1,726,667	0.36	0.16
	High-Efficiency Fireplaces	CML	295	16,606	$ 353,129	$ 41,915,811	$ 74,426	$ 1,801,093	0.25	0.21
H	Efficient Dishwashers	CML	516	17,122	$ 1,088,993	$ 43,004,804	$ 377,905	$ 2,178,998	0.73	0.35
	Efficient Front-Loading Clothes Washers	CML	20	17,141	$ 14,943	$ 43,019,748	$ 6,234	$ 2,185,231	0.32	0.42
	High-Efficiency Fireplaces	F. Unconstrained	99	17,240	$ 111,782	$ 43,131,530	$ 63,842	$ 2,249,073	0.65	0.57
I	High-Performance Windows	CML	1636	18,876	$ 2,710,391	$ 45,841,921	$ 3,857,171	$ 6,106,244	2.36	1.42
	Solar Pre-Heated Make-Up Air	CML	678	19,553	$ 213,677	$ 46,055,598	$ 570,731	$ 6,676,975	0.84	2.67
	DHW Temperature Reduction	CML	36	19,589	$ 13,228	$ 46,068,826	$ 50,000	$ 6,726,975	1.39	3.78
	Ceiling Insulation	CML	19	19,608	$ 2,396	$ 46,071,222	$ 18,349	$ 6,745,324	0.98	7.66
	Solar Pre-Heated Make-Up Air	F. Unconstrained	627	20,235	$ 266,655	$ 46,337,878	$ 2,367,268	$ 9,112,592	3.78	8.88
	Air Sealing and Insulation (Old Homes)	CML	1891	22,126	$ 173,806	$ 46,511,683	$ 1,875,989	$ 10,988,581	0.99	10.79
	Ceiling Insulation	F. Unconstrained	112	22,238	$ 18,751	$ 46,530,434	$ 204,098	$ 11,192,679	1.82	10.88
J	Air Sealing and Insulation (Old Homes)	F. Unconstrained	11328	33,566	$ 1,485,712	$ 48,016,146	$ 20,863,983	$ 32,056,662	1.84	14.04
	Solar Orphans Program	F. Unconstrained	81	33,646	$ 1,135	$ 48,017,281	$ 42,377	$ 32,099,039	0.53	37.33
	Solar Orphans Program	CML	50	33,697	$ 530	$ 48,017,812	$ 25,457	$ 32,124,496	0.51	47.99
	Super High-Performance Windows	CML	425	34,121	$ -	$ 48,017,812	$ 1,298,272	$ 33,422,768	3.06	N/A
	Super High-Performance Windows	F. Unconstrained	902	35,024	$ -	$ 48,017,812	$ 2,763,279	$ 36,186,046	3.06	N/A
						Weighted Average (@ $10M Spending)			0.47	0.22
						Weighted Average (@ $20M Spending)			0.74	0.42
						Weighted Average (Total)			1.03	0.75

** Savings shown are incremental to those for preceding measures.

Exhibit 3.16: Achievable Potential Supply Curve, 2017: Program Cost vs. TRC Net Benefits, for the Total Enbridge Service Area

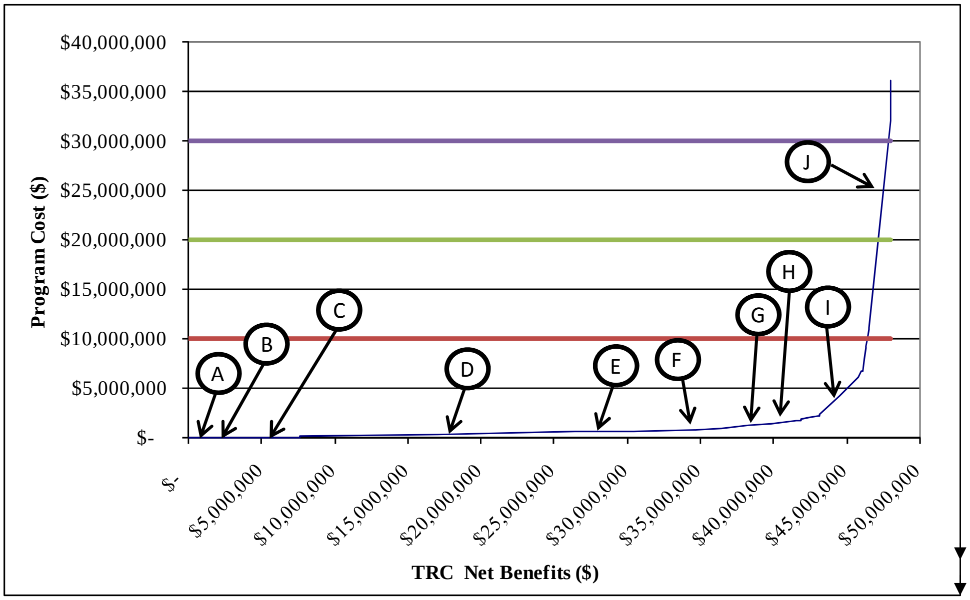
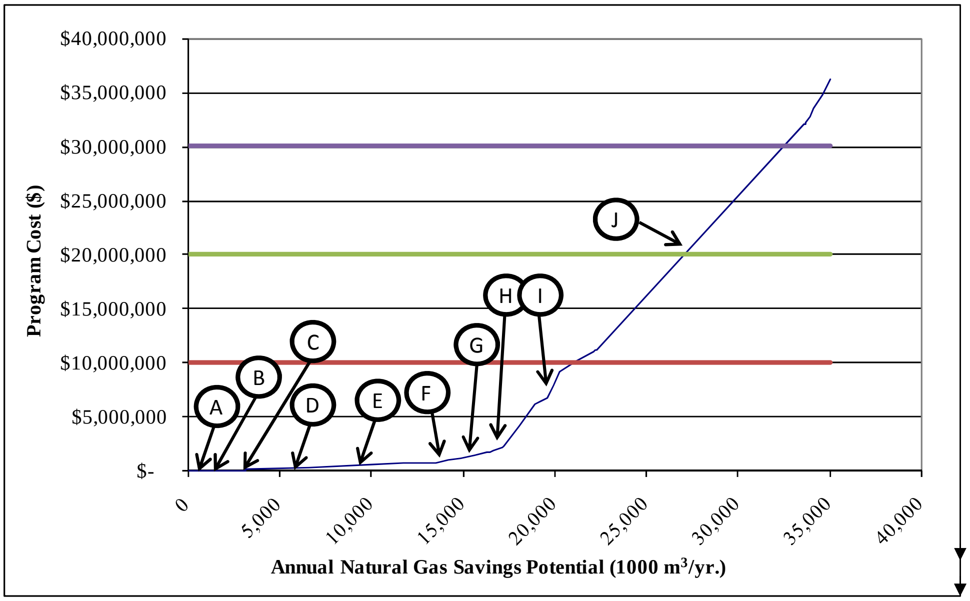


Exhibit 3.17: Achievable Potential Supply Curve, 2017: Program Cost vs. Annual Gross Natural Gas Savings Potential, for the Total Enbridge Service Area



3.7.5 Conclusions

Selected highlights are provided below.

- Program costs per dollar of TRC net benefits increase over the study period to 2017. This is because the measures with low installed cost are assumed to follow a more rapid adoption curve (Curve C, as described in the workshop), leaving more expensive measures to dominate the mixture in later years of the program.

- The supply curves show a sharp increase in program costs associated with capturing additional savings past an annual program spending of level of approximately $10 million on residential DSM.

- With residential program spending of approximately $10M in 2017, program costs are approximately $0.47 per gross m^3 of natural gas savings and $0.22 per dollar of gross TRC benefits. If residential program spending increases to $20M in the same year, program costs increase substantially to approximately $0.74 per gross m^3 of natural gas savings and $0.42 per dollar of gross TRC benefits. This compares with recent Enbridge monitoring and evaluation results[16] of $0.32 m^3 of gross natural gas savings ($0.51 per m^3 of net savings).

- The measures that provide the most significant contribution to annual savings differ somewhat by milestone year. Measures that offer particularly significant natural gas savings potential in both milestone years include air sealing in older homes, programmable thermostats, and high-performance windows. Measures such as ultra low-flow showerheads provide large savings in 2012 but not in 2017 as they are assumed to have fully penetrated the market by 2017.

- Although the weighted average program costs associated with each of the financially constrained scenarios will vary depending on the specific composition of future program portfolios[17], there is an evident trend towards higher future program costs to achieve natural gas savings and TRC benefits. This trend recognizes that savings from DSM programs tend to become more expensive with time as the most attractive measures gain greater market penetration and new performance standards are introduced, which leaves the more challenging measures.

[16] Enbridge, 2007 LRAM Post Audit Results.

[17] Design of a DSM program portfolio is beyond the scope of this current study.

3.8 ADDITIONAL OBSERVATIONS

Two additional observations warrant note as they may affect future residential program strategies. They include:

- ***Niche Markets Warrant Greater Program Focus:*** As the DSM market matures within Enbridge's service area, niche or target markets are becoming increasingly important. For example, measures that may not pass the TRC test in a "typical" or "average" application often will pass in niche applications. Air sealing and insulation in older homes (built before 1980) is one example that was included in this study, as data were available. Similarly, additional domestic hot water measures may be feasible in homes with a larger number of occupants. For example, drain water heat recovery systems and DHW recirculation systems become more economically attractive with larger household sizes. These latter measures have not been included in the current results as suitable data were not available.

- ***Market Transformation Approaches Warrant Additional Consideration***: The technology cost sensitivity analysis showed that there remains an additional untapped potential savings by 2017 of about 1,100 million m^3 from technically mature measures that do not currently pass the TRC screen. The largest share of these additional potential savings is from air sealing and envelope insulation in existing homes. These measures do not pass the TRC screen as currently defined. However, they provide non-energy benefits such as increased comfort and reduced noise that are not currently captured in the TRC calculation. Similarly, industry specialists emphasized that as insulation levels increase, proper air and moisture sealing is becoming increasingly essential to the long-term structural integrity of Ontario's housing stock. This situation presents both an opportunity and a possible technical issue that may be better addressed through a market transformation approach.

4. COMMERCIAL SECTOR

The Commercial sector includes office and retail buildings, hotels and motels, restaurants, warehouses and a wide variety of small buildings. In this study, it also includes buildings that are often classified as “institutional,” such as hospitals and nursing homes, schools and universities.

Throughout this report, use of the word “commercial” includes both commercial and institutional buildings unless otherwise noted.

4.1 APPROACH

The detailed end-use analysis of energy efficiency opportunities in the Commercial sector employed two linked modelling platforms: **CEEAM** (Commercial Energy and Emissions Analysis Model), a Marbek in-house simulation model developed in conjunction with Natural Resources Canada (NRCan) for modelling natural gas use in commercial/institutional building stock, and **CSEEM** (Commercial Sector Energy End-use Model), an in-house spreadsheet-based macro model.

The major steps in the general approach to the study were outlined earlier in Section 1.4 (Approach). Specific procedures for the Commercial sector were as follows:

- **Modelling of Base Year –** Marbek compiled data that defines “where” and “how” natural gas is currently used in existing commercial buildings. The consultants then created building energy use simulations for each type of commercial building and calibrated the models to reflect actual Enbridge customer sales data. Estimated savings for the Other Commercial Buildings category were derived from the results of the modelled segments. They did not directly model that category because it is extremely diverse and the natural gas use of individual facility types is relatively small. The consultant’s model produced a close match with actual Enbridge sales data.

- **Reference Case Calculations –** For the Commercial sector, Marbek developed detailed profiles of new buildings in each of the building segments, estimated the growth in building stock and estimated “natural” changes affecting Natural gas consumption over the study period. As with the Base Year calibration, the consultant’s projection closely matches the Enbridge 2007 forecast of future natural gas requirements.

- **Assessment of DSM Measures** - To estimate the economic and achievable natural gas savings potentials, the consultants assessed a wide range of commercially available DSM measures and technologies such as:

  - Measures to improve building envelope efficiency
  - Measures to reduce domestic hot water use, including solar hot water systems
  - Upgraded heating and ventilating systems
  - Improved construction in new buildings
  - Efficient cooking appliances.

4.2 COMMERCIAL NATURAL GAS SAVINGS POTENTIAL

A summary of the levels of annual natural gas consumption and potential natural gas savings contained in each of the Commercial sector forecasts addressed by the study are presented in Exhibits 4.1 to 4.3 and discussed briefly in the sub sections that follow.

Exhibit 4.1: Graphic of Forecast Results for the Enbridge Service Area – Annual Natural Gas Consumption, Commercial Sector (million m³/yr)

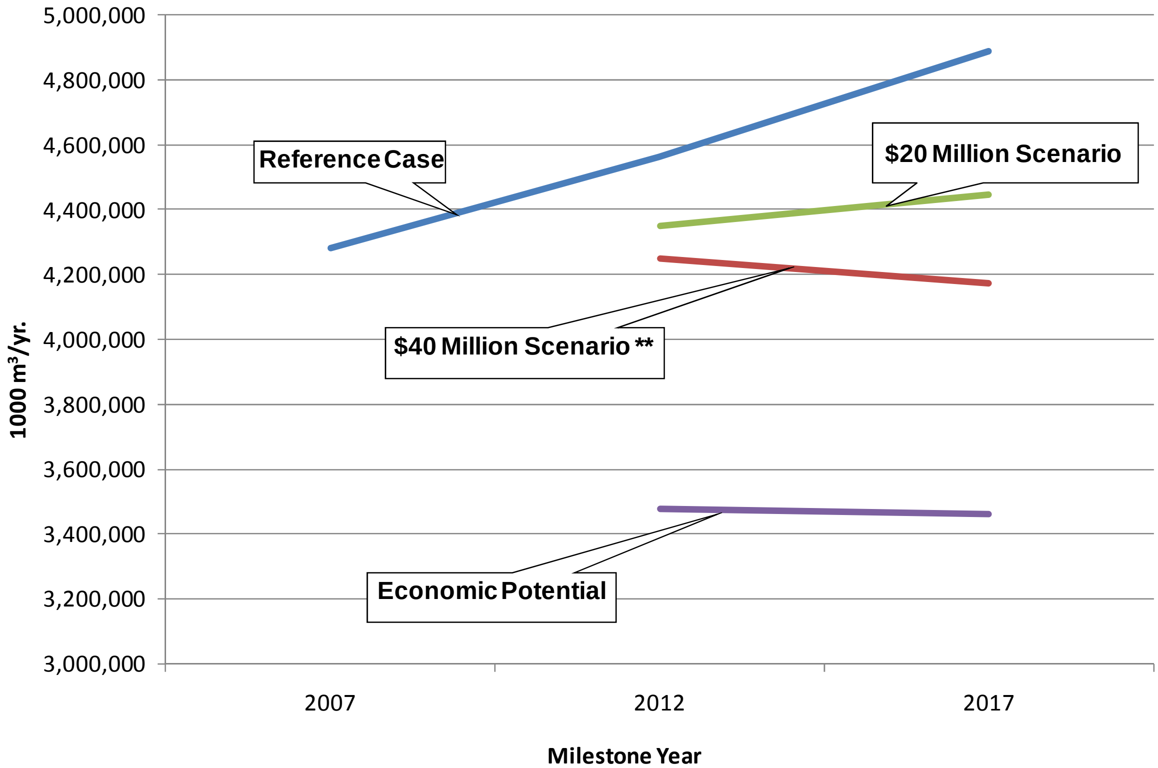


Exhibit 4.2: Summary of Forecast Results for the Total Enbridge Service Area - Annual Natural Gas Consumption, Commercial Sector (million m³/yr)

Milestone Year	Annual Consumption in Commercial Sector (million m³/yr.)					
	Reference Case	Economic Potential	Achievable Potential			
			$20M Scenario	$40M Scenario*	$60M Scenario	Financially Unconstrained
2007	4,281					
2012	4,561	3,479	4,350	4,251	**	4,251
2017	4,888	3,461	4,447	4,172	**	4,172

Note: Estimated annual program costs for implementing all cost-effective Commercial sector measures is $10.9 million, moderately less than the $12 million allocated to the commercial sector in the $40 million DSM scenario. Based on the Achievable workshop results, no additional savings were identified in the $60 million or Financially Unconstrained scenarios, while maintaining a positive TRC.

Exhibit 4.3: Summary of Forecast Results for the Total Enbridge Service Area – Achievable Natural Gas Savings in Milestone Years, Commercial Sector (million m^3/yr. and % Relative to Economic Potential Scenario)

Milestone Year	Natural Gas Savings (million m^3/yr., % Relative to Economic Potential)				
	Economic Potential	Achievable Potential			
		$20M Scenario	$40M Scenario*	$60M Scenario	Financially Unconstrained
2012	1,082	212	310	**	310
2017	1,427	440	715	**	715
2012		20%	29%	**	29%
2017		31%	50%	**	50%

Note**:** Natural gas savings in the milestone years represent the potential reduction in gas use in that year as a result of DSM measures implemented in the period. Based on the Achievable workshop results, no additional savings were identified in the $60 million or Financially Unconstrained scenarios, while maintaining a positive TRC.

4.3 BASE YEAR NATURAL GAS USE

In the Base Year of 2007, the Commercial sector in Enbridge's total service area consumed about 4,200,439,000 m^3. The Central service region accounts for approximately 78% of the total commercial sector sales shown in Exhibit 4.4; the Eastern service region accounts for the remaining 22%.

Among the modelled sub sectors shown in Exhibit 4.4, high-rise apartments, mid-rise apartments and large offices are the three largest natural gas users.

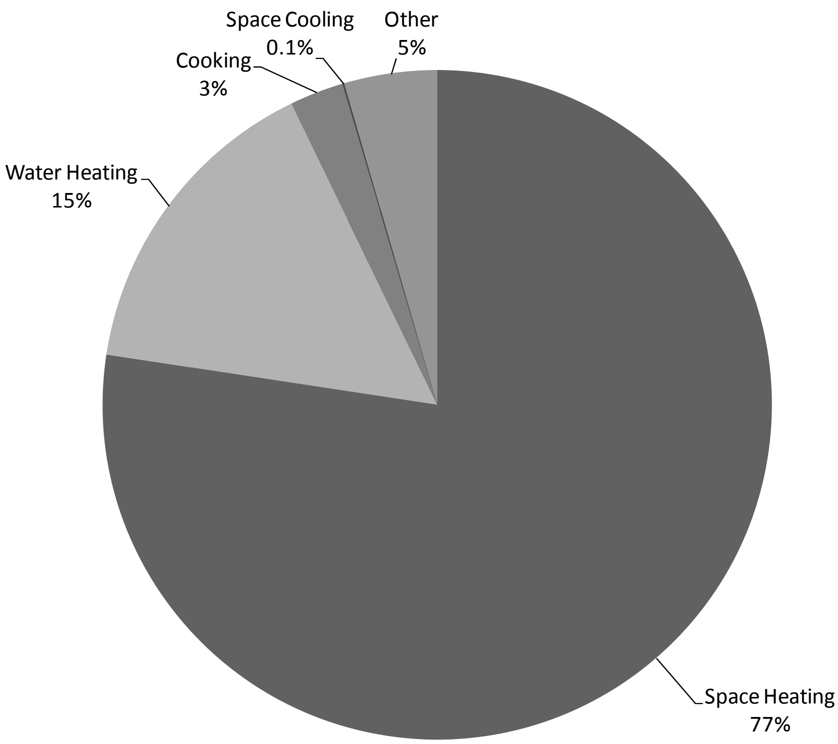
The Other Commercial Buildings sub sector, which is also a large natural gas user, includes buildings that do not fit into any of the remaining sub sectors listed in Exhibit 4.4. These include buildings used for recreational purposes, religious buildings, laundromats, gas stations/car washes, institutional buildings such as correctional facilities, and numerous other building types. Finally, the "Other" sub sector shown in Exhibit 4.4 includes Enbridge customer accounts with missing or unsubstantiated Standard Industrial Classification (SIC) code data. These accounts are classified as "not found" or are unlabelled in the Enbridge sales database.

Exhibit 4.4: Base Year Commercial Sector Natural Gas Use for the Total Enbridge Service Area (1000 m^3/yr)

Sub Sector	Space Heating	Water Heating	Cooking	Space Cooling	Other	Total
Large Office	326,437	34,368	1,431	1,695	53,675	417,606
Small Office	203,775	16,956	691	0	10,360	231,782
Strip Mall	122,794	11,696	5,322	0	6,652	146,464
Retail Services	133,496	8,610	4,366	0	5,458	151,930
Food Retail	62,786	6,173	4,151	0	865	73,975
Large Hotel	20,296	11,489	2,246	232	2,215	36,478
Hotel/Motel	4,239	3,638	97	0	730	8,705
Hospital	78,360	14,835	1,844	503	7,674	103,217
Nursing Home	26,511	8,913	1,993	0	2,835	40,252
School	115,427	7,666	1,789	0	844	125,725
University/College	111,654	15,488	3,742	973	7,128	138,985
Restaurant/Tavern	69,334	27,949	46,130	0	582	143,996
Warehouse/Wholesale	248,854	12,254	510	0	10,195	271,813
Highrise Apartment	578,820	195,990	2,575	0	20,597	797,981
Midrise Apartment	214,163	85,405	844	0	4,222	304,634
Other Commercial Buildings						250,838
Other						956,055
Total	2,316,948	461,429	77,731	3,403	134,034	4,200,439

Exhibit 4.5 shows that space heating accounts for about 77% of total commercial sector natural gas use. Domestic hot water (DHW) accounts for about 15% of the total natural gas use, followed by cooking (3%). A variety of other miscellaneous end uses accounts for the remaining natural gas consumption.

Exhibit 4.5: Base Year Commercial Sector Natural Gas Use for the Total Enbridge Service Area, by End Use[18]



4.4 REFERENCE CASE

In the absence of new DSM initiatives, the study estimates that natural gas consumption in the Commercial sector will grow from 4,200,439,000 $m^{3/}$yr in 2007 to about 4,795,278,000 $m^{3/}$yr in 2017. This represents an overall growth of about 14.2 % in the period and compares very closely with Enbridge‘s own forecast, which also includes consideration of the impacts of “natural conservation.”

Exhibit 4.6 (overleaf) shows the forecast levels of Commercial sector natural gas consumption for the entire Enbridge service area. The results are presented for each milestone year and end use.

[18] The pie chart in Exhibit 4.5 presents percentage of gas consumption by end use for modelled buildings only; the sub sectors “Other Commercial Buildings” and “Other” are included in the total load of the preceding Exhibits, but not included in the pie chart.

Exhibit 4.6: Commercial Sector Reference Case Natural Gas Use for the Total Enbridge Service Area, by Building Type, End use and Milestone Year (1000m^3/yr)

Building Type	Milestone Year	Total	Space Heating	Water Heating	Cooking	Space Cooling	Other
Large Office	2007	417,606	326,437	34,368	1,431	1,695	53,675
	2012	448,243	351,297	37,481	1,617	1,695	56,153
	2017	485,213	381,295	41,238	1,841	1,695	59,143
Small Office	2007	231,782	203,775	16,956	691	0	10,360
	2012	248,787	218,283	18,450	782	0	11,273
	2017	269,334	235,813	20,254	892	0	12,375
Strip Mall	2007	146,464	122,794	11,696	5,322	0	6,652
	2012	157,209	131,547	12,702	5,760	0	7,200
	2017	170,125	142,068	13,911	6,287	0	7,859
Retail Services	2007	151,930	133,496	8,610	4,366	0	5,458
	2012	163,076	142,890	9,493	4,753	0	5,941
	2017	176,550	154,245	10,561	5,220	0	6,525
Food Retail	2007	73,975	62,786	6,173	4,151	0	865
	2012	79,403	67,234	6,713	4,515	0	941
	2017	85,958	72,606	7,365	4,955	0	1,032
Large Hotel	2007	36,478	20,296	11,489	2,246	232	2,215
	2012	39,154	21,465	12,625	2,399	232	2,433
	2017	42,419	22,891	14,011	2,585	232	2,700
Hotel/Motel	2007	8,705	4,239	3,638	97	0	730
	2012	9,343	4,562	3,908	105	0	768
	2017	10,108	4,949	4,231	114	0	814
Hospital	2007	103,217	78,360	14,835	1,844	503	7,674
	2012	110,789	83,801	16,268	2,005	544	8,171
	2017	119,980	90,405	18,007	2,201	593	8,774
Nursing Home	2007	40,252	26,511	8,913	1,993	0	2,835
	2012	43,206	28,499	9,571	2,140	0	2,996
	2017	46,727	30,869	10,355	2,315	0	3,188
School	2007	125,725	115,427	7,666	1,789	0	844
	2012	134,949	123,493	8,565	1,964	0	926
	2017	146,195	133,329	9,661	2,178	0	1,027
University/College	2007	138,985	111,654	15,488	3,742	973	7,128
	2012	149,181	119,911	16,697	4,043	973	7,558
	2017	161,417	129,818	18,148	4,404	973	8,074
Restaurant/Tavern	2007	143,996	69,334	27,949	46,130	0	582
	2012	154,560	74,095	30,167	49,671	0	627
	2017	167,192	79,788	32,819	53,904	0	681
Warehouse/Wholesale	2007	271,813	248,854	12,254	510	0	10,195
	2012	291,754	266,608	13,413	559	0	11,175
	2017	316,025	288,215	14,825	618	0	12,367
Highrise Apartment	2007	797,981	578,820	195,990	2,575	0	20,597
	2012	839,325	604,815	209,824	2,743	0	21,943
	2017	883,072	632,322	224,463	2,921	0	23,367
Midrise Apartment	2007	304,634	214,163	85,405	844	0	4,222
	2012	320,418	224,504	90,495	945	0	4,474
	2017	337,028	235,387	95,852	1,051	0	4,738
Other Commercial Buildings	2007	250,838					
	2012	267,272					
	2017	286,406					
Other	2007	956,055					
	2012	1,018,655					
	2017	1,091,528					
Total	2007	4,200,439	2,316,948	461,429	77,731	3,403	134,034
	2012	4,475,324	2,463,003	496,371	84,000	3,444	142,579
	2017	4,795,278	2,633,999	535,700	91,488	3,493	152,664

4.5 ASSESSMENT OF ENERGY EFFICIENCY MEASURES

The study assessed over 40 potential energy efficiency measures. A summary of the screening results for the energy-efficiency measures is presented in Exhibit 4.7. Due to the number of measures assessed, Exhibit 4.7 shows only the results for options in the Central service region.

Exhibit 4.7: Summary of Measure TRC Screening Results Commercial Sector Energy-efficiency Options – Central Region

Measure Name	Target Market			Simple Payback (Yrs)	B/C Ratio
	Sub Sector(s)	Vintage	Full/ Incr		
High-Performance Glazings	All	E	I	5.3	1.56
Super High-Performance Glazings	All	E	I	15.9	0.52
Wall Insulation	All	E	I	28.7	0.25
Roof Insulation	All	E	I	7.1	1.00
Air Sealing	All	E	F	3.5	0.92
Air Curtains	All	E	F	1.1	5.52
Condensing Boiler - Baseline: Standard Boiler - 1,500 FLE hours	All	E	I	5.0	1.58
Condensing Boiler - Baseline: Near-condensing - 1,500 FLE hours	All	E	I	7.6	1.04
Near Condensing Boiler - Baseline: Standard Boiler - 1,500 FLE hours	All	E	I	1.8	4.33
Condensing Unit heater - Baseline: Standard efficiency - 1,500 FLE hours	All	E	I	2.3	2.96
High-Efficiency Rooftop Unit - Baseline: Standard efficiency - 1,500 FLE hours	All	E	I	2.1	2.96
Condensing Rooftop Unit - Baseline: Standard efficiency - 1,500 FLE hours	All	E	I	4.8	1.28
Gas Absorption Heat Pump - Baseline: standard efficiency boiler - 1,500 FLE hours	All	E	I	2.7	2.29
Steam Plant Efficiency Measures	All	E	F	1.2	4.00
HVLS Destratification Fans	All	E	F	3.4	1.77
Heat Reflector Panels	All	E	F	3.2	2.10
Programmable Heating Controls	All	E	F	2.3	2.72
Heat Recovery	All	E	F	3.2	1.91
Demand Controlled Ventilation	All	E	F	1.5	2.87
Demand Control Kitchen Ventilation	All	E	F	1.8	3.69
Condensing Furnace	All	E	I	2.4	2.81
Ground Source Heat Pumps	All	E	I	24.6	0.61
Solar Preheated Make-up Air	All	E	F	11.5	0.62
Condensing Water Heater - Baseline: standard efficiency - 1,000 FLE hours	All	E	I	3.9	1.83
Condensing Storage Water Heater - Baseline: standard efficiency - 1,000 FLE hours	All	E	I	3.1	1.79
Tankless Water Heater - Baseline: standard efficiency - 1,000 FLE hours	All	E	I	5.5	1.19
Solar Weater Heating System - Baseline: standard efficiency - 1,000 FLE hours	All	E	F	19.1	0.33
Drainwater Heat Recovery - 10 minute shower, 3 times per day	All	E	I	9.2	0.70
Low-Flow Faucet Aerators - 3 min/day	All	E	F	0.4	9.53
Low-Flow Showerheads - 10 min/day	All	E	F	0.3	12.45
Pre-Rinse Spray Valve - 40 min/day	All	E	F	0.3	8.42
High-Efficiency Gas Griddle	All	E	I	5.1	0.87
High-Efficiency Gas Broiler	All	E	I	0.5	8.73
High-Efficiency Gas Oven	All	E	I	7.8	0.56
ENERGY STAR ® Fryer	All	E	I	3.7	1.18
High-Efficiency Gas Range Top	All	E	I	2.4	1.86
Building Recommissioning	All	E	F	0.7	3.31
Advanced Building Automation Systems	All	E	F	2.9	1.47
New Construction - 25% more efficient	All	N	I	3.9	1.78
New Construction - 40% more efficient	All	N	I	4.0	1.74

4.6 ECONOMIC POTENTIAL FORECAST

Under the conditions of the Economic Potential Forecast,[19] the study estimated that natural gas consumption in the Commercial sector would decline to about 3,461,000,000 $m^{3/}$yr by 2017 for the total Enbridge service area. Annual savings relative to the Reference Case are about 1,427,000,000 $m^{3/}$yr by 2017, or about 29%. Further details are provided in Exhibit 4.8, which show the results for both milestone years by sub sector and end use.

4.6.1 Sensitivity Analysis

The Economic Potential results were subjected to a sensitivity analysis around two of the assumptions employed: Technology Cost and inclusion of a value for GHG emissions (as described in Step 5, in Section 1.4). The two sensitivity analyses offer the following insights:

- In the commercial sector, there are relatively few measures that do not pass the economic screen (10 of a total of 40 evaluated measures). Moreover, the additional 10 measures included in the Technology Cost sensitivity analysis provide only modest additional savings relative to the technologies already included in the Economic Potential Forecast.

- The Technology Cost sensitivity analysis identified potential savings of about 1,680 million m^3 in 2017; this compares with identified savings potential of about 1,399 million m^3 in 2017 under the Economic Potential forecast. Hence, the identified Technical savings potential is about 20% greater than that identified in the Economic Potential forecast.

- The GHG adder makes a relatively small difference to the overall avoided cost of energy, and therefore, only one additional measure passes the economic screen. Potential savings are increased by about 2%.

[19] The level of natural gas consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost-effective. In this study, “cost-effective” means that the technology upgrade passes the measure Total Resource Cost (TRC) test

Exhibit 4.8: Natural Gas Savings by Sub Sector, End Use and Milestone Year, Total Enbridge Service Region (1000 m^3/yr.)

Sub sector	Milestone Year	Total	Space Heating	Water Heating	Cooking	Space Cooling	Other
Large Office	2012	114,101	90,126	13,497	113	242	10,124
	2017	144,031	113,723	17,006	257	242	12,804
Small Office	2012	65,476	58,022	5,268	55	0	2,131
	2017	87,524	77,237	7,301	124	0	2,862
Strip Mall	2012	41,587	35,125	4,702	402	0	1,359
	2017	58,335	49,648	5,996	877	0	1,813
Retail Services	2012	40,488	35,764	3,280	331	0	1,113
	2017	55,442	49,157	4,069	728	0	1,488
Food Retail	2012	18,809	16,413	1,902	315	0	179
	2017	25,898	22,340	2,626	691	0	241
Large Hotel	2012	9,626	4,911	4,048	167	33	467
	2017	12,719	6,938	4,750	360	33	638
Hotel/Motel	2012	2,453	1,024	1,281	7	0	141
	2017	3,143	1,456	1,491	16	0	180
Hospital	2012	28,336	21,360	5,414	140	88	1,335
	2017	36,719	28,187	6,499	307	108	1,618
Nursing Home	2012	12,799	8,846	3,260	149	0	543
	2017	15,567	10,640	3,910	323	0	694
School	2012	29,841	26,668	2,865	137	0	171
	2017	41,314	37,273	3,509	304	0	229
University/College	2012	38,890	31,826	5,369	282	139	1,275
	2017	51,299	42,790	6,189	614	139	1,568
Restaurant/Tavern	2012	36,898	22,790	10,527	3,462	0	118
	2017	48,391	27,877	12,843	7,515	0	156
Warehouse/Whole sale	2012	81,106	75,090	3,815	39	0	2,162
	2017	106,741	98,392	5,306	86	0	2,957
High-rise Apartment	2012	213,867	139,707	69,916	191	0	4,052
	2017	281,577	194,612	81,357	407	0	5,201
Mid-rise Apartment	2012	83,772	51,533	31,358	66	0	815
	2017	110,115	71,733	37,202	146	0	1,033
Other Commercial Buildings	2012	51,397					
	2017	67,753					
Other	2012	212,473					
	2017	280,138					
Total	2012	1,081,920	619,206	166,503	5,855	501	25,983
	2017	1,426,706	832,003	200,055	12,755	521	33,482

4.7 ACHIEVABLE POTENTIAL

As noted previously, Achievable Potential was assessed from two perspectives: [20]

- Potential Savings in Future Natural Gas Consumption: Savings in one year due to the Aggregate impact of measures implemented over the time period of Base Year (2007) to Milestone Year (2012 and 2017). This method calculates the net change in future natural gas supply requirements.

- Potential DSM Program TRC Benefits. [21] Savings due to (only) those measures implemented in one year. This method is used in calculation of the net TRC benefits.

Within each of the above perspectives, the analysis of Achievable Potential was assessed under four different Marketing scenarios:

- One Financially Unconstrained scenario
- Three Financially Constrained scenarios, each limited by a different level of program budget availability.

Further detail related to each of the Marketing scenarios is provided below followed by a summary of results.

4.7.1 Financially Unconstrained DSM Marketing Scenario

The Financially Unconstrained scenario provides an overview of the level of potential natural gas savings that could be achieved if a comprehensive portfolio of DSM programs was launched without any constraint on the availability of program funding, except for the requirement to maintain a positive TRC.

Although the results of this scenario are not constrained by program funding, the results do incorporate consideration of the market constraints identified during the Achievable Potential workshop, such as product and service availability and customer transaction costs.

This scenario, therefore, provides a high-level estimate of the upper level of natural gas savings that could be achieved by Enbridge's commercial customers over the nine-year period beginning in 2009 and ending in 2017. It also provides Enbridge's DSM program personnel with a view of the relative potential contribution of individual sub sectors, end uses, technologies and service regions.

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[20] See definition of savings as provided in Step 6, page 7.

[21] The annual savings presented do not explicitly address the potential impact of free riders at the level of individual program measure. However, the Reference Case 3 does include an estimate of the impact of natural conservation over the study period, by end use (i.e., an estimate of natural gas savings that would occur in the absence of additional Enbridge DSM programs). Hence, the inclusion of natural conservation in the study's Reference Case does address some, but not necessarily all, free rider and spillover impacts. A more detailed assessment of free rider and spillover impacts is practical only as part of a detailed program design, which is beyond the scope of this study.

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Major Assumptions: Financially Unconstrained Scenario

- All measures that pass the measure TRC screen are included
- No program financial limit is set, except that all measures must continue to pass the measure TRC screen
- Participation rates for each measure are based on the workshop results, which consider both market barriers and potential promotional strategies.

Exhibit 4.9 provides details on the program costs assumed for each measure.

Exhibit 4.9: Summary of Program Cost Assumptions, Financially Unconstrained Scenario[22]

Measure Name	Fixed Program Costs per bundle ($/yr.)	Incentive Amount ($/$m^3$ saved)	Simple Payback After Incentive (yrs.)
High-Performance Glazings	$ 75,000	$ 0.332	4.6
Roof insulation		$ 0.332	6.4
Air Curtains	$ 14,000	$ 0.277	0.9
Condensing Boiler - Baseline: Standard Boiler	$ 60,000	$ 0.221	4.5
Condensing Boiler - Baseline: Near Condensing		$ 0.221	7.1
Near-Condensing Boiler		$ 0.221	1.3
Condensing Unit Heater	$ 60,000	$ 0.332	1.6
High-Efficiency Rooftop Unit		$ 0.277	1.5
Condensing Furnace		$ 0.221	1.9
Demand Controlled Ventilation	$ 70,000	$ 0.332	0.8
Demand Control Kitchen Ventilation		$ 0.508	1.1
Heat Recovery		$ 0.332	2.5
Condensing Water Heater	$ 40,000	$ 0.332	3.3
Condensing Storage Water Heater		$ 0.332	2.4
Low-Flow Faucet Aerators	$ 2,500	$ 0.042	0.4
Low-Flow Showerheads		$ 0.042	0.3
Pre-Rinse Spray Valve	$ 40,000	$ 0.300	0.1
High-Efficiency Broiler	$ 40,000	$ 0.332	-0.2
ENERGY STAR® Fryer		$ 0.332	3.0
High-Efficiency Range		$ 0.332	1.7
Building Recommissioning	$ 600,000	$ 0.249	0.6
Advanced Building Automation Systems		$ 0.249	2.7
Steam Plant Efficiency Measures		$ 0.249	0.7
HVLS Destratification Fans	$ 20,000	$ 0.332	2.7
New Construction - 25% More Efficient	$ 735,000	$ 0.159	3.8
New Construction - 40% More Efficient		$ 0.159	3.9

22 Salary and related overhead costs are not included in program cost estimates. Also, the incentive levels are capped at 100% of the indicated measure cost.

4.7.2 Financially Constrained DSM Marketing Scenarios

These DSM scenarios provide estimates of the potential impacts of increasingly larger annual DSM budgets, which as noted previously were set at $20, $40 and $60 million, annually. Within each of these budgets, 30% of the funding is allocated to the Commercial sector for the purposes of this analysis.

The financially constrained scenarios include the following DSM costs:

- **Fixed Program Costs**: This includes costs for items such as newspaper advertisements, preparation of information and marketing materials, training workshops, contractor certifications, etc. These program cost elements are not expected to vary significantly if the number of installations of the measure changed. Estimates for these cost items were provided by Enbridge personnel, based on current and previous experience with similar DSM measures. In each case, these costs are expressed as dollars of program spending per year. For each of the measures, fixed program costs were estimated for both the CML and Financially Unconstrained Marketing scenarios. Salary and related overhead costs are not included.

- **Incentive Costs**: These costs would include any costs that vary directly according to the number of installations of the measure. Incentive amounts vary by measure and are expressed as dollars per m^3 gas saved.

Exhibit 4.10 provides details on the program costs assumed for each measure.

Exhibit 4.10: Summary of Program Cost Assumptions, CML Scenario[23]

Measure Name	Fixed Program Costs per bundle ($/yr.)	Incentive Amount ($/m^3 saved)	Simple Payback After Incentive (yrs.)
High-Performance Glazings	$ 50,000	$ 0.100	5.1
Roof Insulation		$ 0.100	6.9
Air Curtains	$ 7,000	$ 0.100	1.0
Condensing Boiler - Baseline: Standard Boiler		$ 0.100	4.7
Condensing Boiler - Baseline: Near Condensing	$ 40,000	$ 0.100	7.3
Near-Condensing Boiler		$ 0.100	1.6
Condensing Unit Heater		$ 0.100	2.1
High-Efficiency Rooftop Unit	$ 40,000	$ 0.100	1.9
Condensing Furnace		$ 0.100	2.2
Demand Controlled Ventilation		$ 0.100	1.3
Demand Control Kitchen Ventilation	$ 35,000	$ 0.152	1.6
Heat Recovery		$ 0.100	3.0
Condensing Water Heater	$ 20,000	$ 0.100	3.7
Condensing Storage Water Heater		$ 0.100	2.9
Low-Flow Faucet Aerators	$ 1,000	$ 0.025	0.4
Low-Flow Showerheads		$ 0.025	0.3
Pre-Rinse Spray Valve	$ 20,000	$ 0.120	0.2
High-Efficiency Broiler		$ 0.100	0.3
ENERGY STAR® Fryer	$ 20,000	$ 0.100	3.5
High-Efficiency Range		$ 0.100	2.1
Building Recommissioning		$ 0.100	0.7
Advanced Building Automation Systems	$ 400,000	$ 0.100	2.8
Steam Plant Efficiency Measures		$ 0.100	1.0
HVLS Destratification Fans	$ 10,000	$ 0.100	3.2
New Construction - 25% More Efficient	$ 490,000	$ 0.064	3.8
New Construction - 40% More Efficient		$ 0.064	3.9

[23] Salary and related overhead costs are not included in program cost estimates. Also, the incentive levels are capped at 100% of the indicated measure cost.

4.7.3 Achievable Potential Savings – Future Natural Gas Consumption

Exhibits 4.11 and 4.12 present a summary of the Achievable Potential savings in future natural gas consumption relative to the Reference Case levels. For illustration, the results of the Financially Unconstrained scenario are shown. Selected highlights are provided below.

- Exhibit 4.11 shows that total Commercial sector natural gas savings in 2017 are estimated to be approximately 715 million m^3/yr. This represents a savings of approximately 15%, relative to the Reference Case and is equal to approximately 50% of the savings identified in the Economic Potential Forecast. The Central service region accounts for about 81% of the identified potential.
- Exhibit 4.12 shows the results by sub sector and end use for the Enbridge Service Area. As illustrated, the majority of savings are associated with the space heating end use (74%), while three sub sectors (High-rise Apartment, Other Buildings and Large Office) account for nearly 50% of total savings under this scenario.

Exhibit 4.11: Natural Gas Savings by Service Region and Milestone Year, Financially Unconstrained Scenario (1000 m^3/yr.)

Milestone Year	Central service region (1000 m^3/yr.)	Eastern service region	Total	% Savings Relative to Ref Case
2012	251,047	59,149	310,196	7%
2017	580,405	135,008	715,414	15%
% Savings 2017 Re: Reference Case	14%	15%	15%	
% Savings 2017 Re: Total	81%	19%	100%	

Exhibit 4.12: Natural Gas Savings by End Use and Milestone Year for the Total Enbridge Service Area, Financially Unconstrained Scenario (1000 m^3/yr.)

Sub sector	Milestone Year	Total	Space Heating	Water Heating	Cooking	Space Cooling	Other
Large Office	2012	34,632	27,494	4,150	38	80	2,869
	2017	77,260	61,159	9,291	139	163	6,508
Small Office	2012	16,742	14,716	1,480	18	0	528
	2017	38,979	34,105	3,552	66	0	1,256
Strip Mall	2012	9,639	7,945	1,252	133	0	310
	2017	23,734	19,625	2,896	462	0	751
Retail Services	2012	11,390	9,977	994	112	0	306
	2017	26,898	23,579	2,203	392	0	725
Food Retail	2012	5,404	4,659	582	115	0	49
	2017	12,779	10,884	1,378	402	0	116
Large Hotel	2012	2,815	1,387	1,238	53	11	126
	2017	6,510	3,332	2,672	181	22	302
Hotel/Motel	2012	668	265	364	2	0	36
	2017	1,524	641	793	9	0	82
Hospital	2012	8,811	6,449	1,831	53	29	449
	2017	20,450	15,204	3,975	185	66	1,020
Nursing Home	2012	3,833	2,637	999	48	0	148
	2017	8,430	5,722	2,199	167	0	342
School	2012	9,564	8,507	956	50	0	52
	2017	22,720	20,328	2,092	177	0	123
University/College	2012	12,006	9,597	1,852	95	51	412
	2017	27,617	22,293	3,966	328	103	926
Restaurant/Tavern	2012	10,386	6,056	3,140	1,161	0	30
	2017	24,479	13,326	7,068	4,015	0	71
Warehouse/Wholesale	2012	20,479	19,002	983	13	0	480
	2017	47,430	43,809	2,400	45	0	1,175
High-rise Apartment	2012	62,916	39,869	21,853	64	0	1,131
	2017	144,451	94,195	47,459	217	0	2,580
Mid-rise Apartment	2012	24,969	14,521	10,197	22	0	228
	2017	57,094	34,105	22,393	79	0	517
Other Commercial Buildings	2012	14,832					
	2017	34,177					
Other	2012	61,111					
	2017	140,882					
Total	2012	310,196	173,080	51,870	1,979	171	7,153
	2017	715,414	402,307	114,336	6,865	355	16,492

4.7.4 Potential DSM Program TRC Benefits

Exhibits 4.13, 4.14 and 4.15 present the results for the milestone year 2017. As illustrated, annual Commercial sector program spending of approximately $10.4 million in 2017 is estimated to result in the installation of measures providing approximately 67 million m^3/year in natural gas savings[24] and approximately $203 million in TRC net benefits. The exhibits also show that annual commercial program spending achieves maximum results at expenditures of $10.4 million in 2012 and $10.9 million in 2017, which is below the allowable Commercial sector program budget of $12 million. This is because additional cost-effective measures were not available while also maintaining a positive TRC. Additional details are provided in the following exhibits.

- Exhibit 4.13 presents the 2017 results by upgrade technology bundle, including both the current marketing level of participation and the increment from CML to financially unconstrained. For each measure bundle, annual natural gas savings potential, net TRC benefits and annual program costs are presented both individually and cumulatively. The measures are sorted in order of increasing program cost per dollar of TRC benefits. The six measure bundles contributing the most TRC benefits are assigned letters, matching the labels on Exhibits 4.13 and 4.14.

- Exhibit 4.14 presents the 2017 results graphically, with program costs on the vertical axis and net TRC benefits on the horizontal axis. The $6 million annual budget level for commercial program spending is shown as a horizontal line for reference.

- Exhibit 4.15 presents the 2017 results graphically, with program costs on the vertical axis and annual natural gas savings potential on the horizontal axis. The $6 million annual budget level for commercial program spending is shown as a horizontal line for reference.

[24] Note: the savings shown are only for the measures installed in 2017; they do not include the savings in 2017 that occur as a result of measures installed in prior periods.

Exhibit 4.13: Summary Achievable Results** by Measure, for the Enbridge Service Area, 2017 Installations

Reference (Marked on Graphs)	Upgrade Technology/Measures	Scenario	Annual Natural Gas Savings Potential (1000 m^3/yr.)		TRC ($)		Annual Program Costs ($)		Program Costs per Unit	
				Cumulative		Cumulative		Cumulative	per Natural Gas Savings ($/$m^3$)	per TRC Benefits ($/$)
A	DHW - Conservation Measures	CML	8,012	8,012	$ 25,087,338	$ 25,087,338	$ 270,758	$ 270,758	$ 0.034	$ 0.011
B	DHW - Conservation Measures	Aggressive	3,923	11,935	$ 12,269,293	$ 37,356,631	$ 250,043	$ 520,801	$ 0.064	$ 0.020
C	New construction - 40% Better	CML	3,316	15,251	$ 23,953,898	$ 61,310,529	$ 692,096	$ 1,212,896	$ 0.209	$ 0.029
D	New construction - 40% Better	Aggressive	3,131	18,382	$ 22,801,127	$ 84,111,655	$ 760,595	$ 1,973,491	$ 0.243	$ 0.033
E	Space Heating / Other - Recommissioning	CML	21,322	39,704	$ 64,963,918	$ 149,075,574	$ 2,523,683	$ 4,497,174	$ 0.118	$ 0.039
	Space Heating - Ventilation Measures - Heat Recovery	CML	3,149	42,853	$ 5,563,440	$ 154,639,013	$ 363,926	$ 4,861,100	$ 0.116	$ 0.065
	Space Heating - Equipment	CML	3,311	46,164	$ 5,160,942	$ 159,799,955	$ 409,752	$ 5,270,852	$ 0.124	$ 0.079
F	Space Heating / Other - Recommissioning	Aggressive	10,260	56,424	$ 31,251,590	$ 191,051,545	$ 2,754,864	$ 8,025,716	$ 0.268	$ 0.088
	DHW - Equipment Measures	CML	1,391	57,815	$ 1,788,785	$ 192,840,330	$ 158,547	$ 8,184,264	$ 0.114	$ 0.089
	Space Heating - Envelope measures (Conductive)	CML	854	58,670	$ 769,917	$ 193,610,246	$ 135,106	$ 8,319,370	$ 0.158	$ 0.175
	Space Heating - Ventilation Measures - Heat Recovery	Aggressive	2,863	61,533	$ 5,053,834	$ 198,664,080	$ 1,031,819	$ 9,351,189	$ 0.360	$ 0.204
	Space Heating - Envelope measures (Mass transfer)	CML	1,056	62,588	$ 479,097	$ 199,143,177	$ 112,141	$ 9,463,330	$ 0.106	$ 0.234
	Space Heating - Envelope measures (Conductive)	Aggressive	2,975	65,564	$ 2,878,361	$ 202,021,539	$ 1,012,833	$ 10,476,162	$ 0.340	$ 0.352
	Space Heating - Envelope measures (Mass transfer)	Aggressive	1,116	66,679	$ 506,902	$ 202,528,440	$ 316,304	$ 10,792,467	$ 0.283	$ 0.624
	Efficient Food Service Equipment	CML	33	66,713	$ 13,068	$ 202,541,509	$ 13,309	$ 10,805,775	$ 0.401	$ 1.018
	Efficient Food Service Equipment	Aggressive	57	66,770	$ 5,767	$ 202,547,275	$ 49,068	$ 10,854,843	$ 0.854	$ 8.509
								Weighted Average (@ $6M spending):	$ 0.114	$ 0.032
								Weighted Average (all measures):	$ 0.163	$ 0.054

** Savings shown are incremental to those for preceding measures.

Exhibit 4.14: Achievable Potential Supply Curve, 2017 Installations: Program Cost vs. TRC Net Benefits, for the Enbridge Service Area

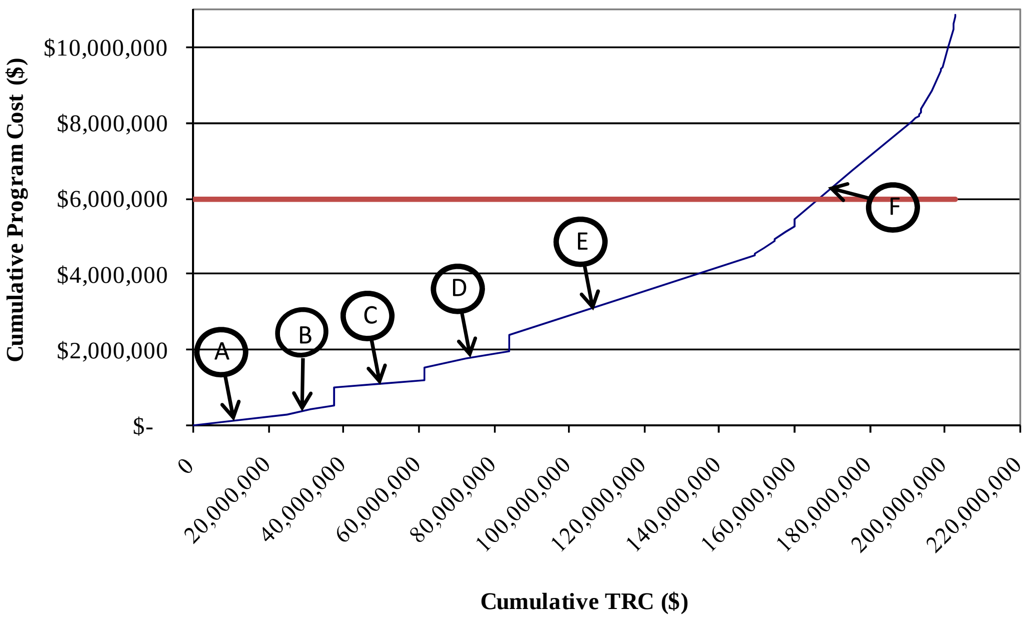
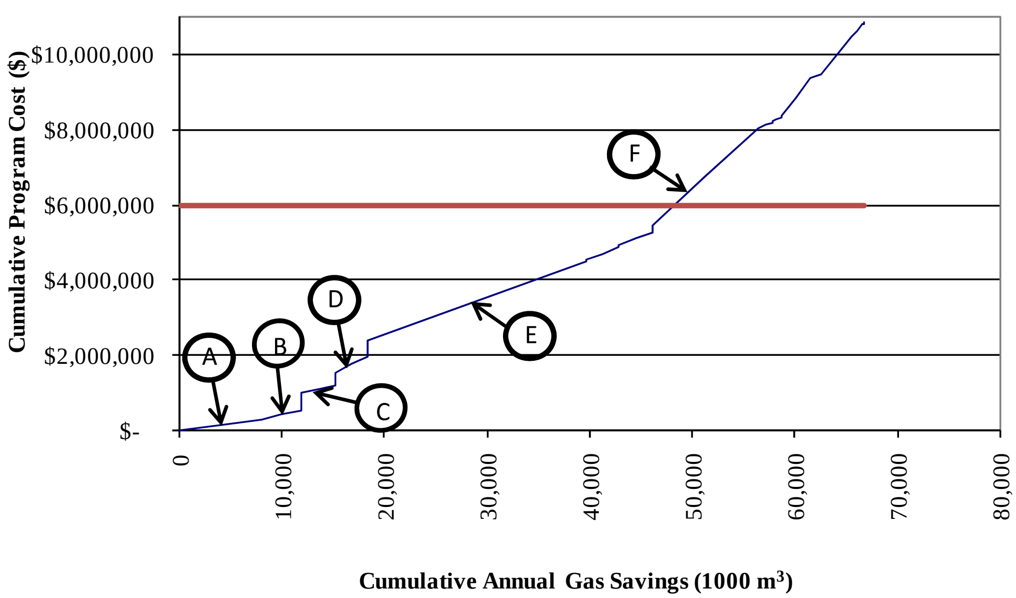


Exhibit 4.15: Achievable Potential Supply Curve, 2017 Installations: Program Cost vs. Annual Natural Gas Savings Potential, for the Enbridge Service Area



4.7.5 Conclusions

Selected highlights are provided below.

- Annual commercial program spending achieves maximum results at expenditures of \$10.4 million in 2012 and \$10.9 million in 2017, which is below the allowable commercial budget of \$12 million. This is because additional cost-effective measures were not available under the conditions defined by this scenario.

- Program costs per dollar of TRC net benefits increase over the study period. This is primarily due to the fact that recommissioning, the largest commercial opportunity, is slightly more expensive on a cost per TRC dollar basis in 2017 than 2012. This reflects a situation in which fixed costs remain constant through time, while yearly savings levels decrease as the most attractive opportunities are realized by the earlier milestone year.

- With commercial program spending of approximately \$10.4 million in 2017, program costs are approximately \$0.16 per m^3 of natural gas savings and \$0.05 per dollar of TRC benefits. This compares with recent Enbridge monitoring and evaluation results[25] of \$0.11 per m^3 of gross natural gas savings (\$0.14 m^3 net of free riders) in 2007.

- For two measure groups (space heating equipment and water heating equipment), savings for the year 2017 are greater under the Financially Constrained scenarios than under the Financially Unconstrained scenario. This reflects a situation in which the majority of the opportunity is realized in early years under the Financially Unconstrained scenario, while savings "ramp up" slowly under the Financially Constrained scenarios.

- Recommissioning represents the largest contribution to annual savings in both milestone years. Other measures that offer particularly significant natural gas savings potential in both milestone years include hot water conservation measures and efficient new construction.

[25] Enbridge Gas, 2007 LRAM Post Audit Results.

4.8 ADDITIONAL OBSERVATIONS

In addition to the preceding conclusions, three additional observations warrant note as they may affect future Commercial sector program strategies. They include:

- ***Rate of measure implementation has a large effect on overall savings:*** For measures that pass the TRC screen on an incremental cost basis, low participation rates in early milestone years create a significant "lost opportunity." This is particularly relevant to the replacement of equipment with a very long life (i.e. space heating equipment), building renovations such as envelope improvements, and new building construction. The gap between Economic Potential and Achievable Potential savings presented in this study is due in large part to this significant lost opportunity that occurs in early milestone years.

- ***Savings arising from full cost measures may be delayed without eroding overall potential:*** This is a corollary of the above point, and most pertinent to the discussion of the largest opportunity identified in this study, recommissioning. As recommissioning passes the TRC screen at full cost, eligible buildings which are not recommissioned remains as future opportunities, while incremental cost opportunities which are not exploited represent lost opportunities. This may be especially relevant to programming strategy during periods of economic downturn, when building owners and managers may be less likely to implement measures despite an attractive payback.

- ***Market transformation approaches warrant additional consideration:*** The technology cost sensitivity analysis showed that there remains an additional untapped potential savings by 2017 of about 269 million m^3 from technically mature measures that do not currently pass the TRC screen. The largest share of these additional potential savings are from air sealing and envelope upgrades, including wall insulation and more energy efficient glazing measures in existing buildings. These measures do not pass the TRC screen as currently defined. However, they provide non-energy benefits such as increased comfort and reduced noise that are not currently captured in the TRC calculation. In addition, industry specialists emphasized that some emerging technologies, such as solar preheated make-up air may be better addressed in a market transformation context, as they provide "soft" benefits, such as visible contribution to corporate greening goals, that are not included in the TRC calculation.

5. INDUSTRIAL SECTOR

The Industrial sector consists of the seven largest natural gas consuming industries within the Enbridge service area plus an additional miscellaneous category that combines eight smaller industry groups. The seven large industries, which are the primary focus of this study, are: Non-metallic Mineral Products, Food Products, Paper Manufacturing, Refined Petroleum and Coal, Chemical Manufacturing, Primary Metals and Fabricated Metals.

5.1 APPROACH

The detailed end-use analysis of energy efficiency opportunities in the Industrial sector employed Marbek's customized macro model. The model is organized by major industrial sub sector and major end use.

Natural gas end-use profiles were developed for the seven sub sectors described above. The profiles map proportionally how much natural gas is used by each of the end uses for each sub sector. These profiles represent the sub sector archetypes and are used in the model to calculate the natural gas used by each end use for each sub sector.

The major steps in the general approach to the study are outlined in Section 1.4 above (Approach). Specific procedures for the Industrial sector were as follows:

- **Modelling of Base Year –** The consultants compiled Base Year data on the industrial sector from a variety of sources, including Enbridge's customer information, the study team's own energy assessment experience within many of the sub sectors and secondary data sources. The macro model results produced a close match with actual Enbridge sales data.

- **Reference Case Calculations -** The consultants prepared a Reference Case forecast based on projected growth forecasts provided by Enbridge, which includes anticipated closing of existing facilities and opening of new facilities.

- **Assessment of DSM Measures –**To estimate the economic and achievable natural gas savings potentials, the consultants assessed a wide range of commercially available energy efficiency measures and technologies such as:

  - Integrated control systems
  - More efficient boiler, steam and hot water systems
  - Efficient process heating technologies
  - Efficient space heating and ventilation, including solar thermal technologies.

5.2 INDUSTRIAL NATURAL GAS SAVINGS POTENTIAL

A summary of the levels of annual natural gas consumption and potential natural gas savings contained in each of the Industrial sector forecasts addressed by the study are presented in Exhibits 5.1 to 5.3 and discussed briefly in the sub sections that follow.

Exhibit 5.1: Graphic of Forecast Results for the Enbridge Service Area – Annual Natural Gas Consumption, Industrial Sector (million m^3/yr)

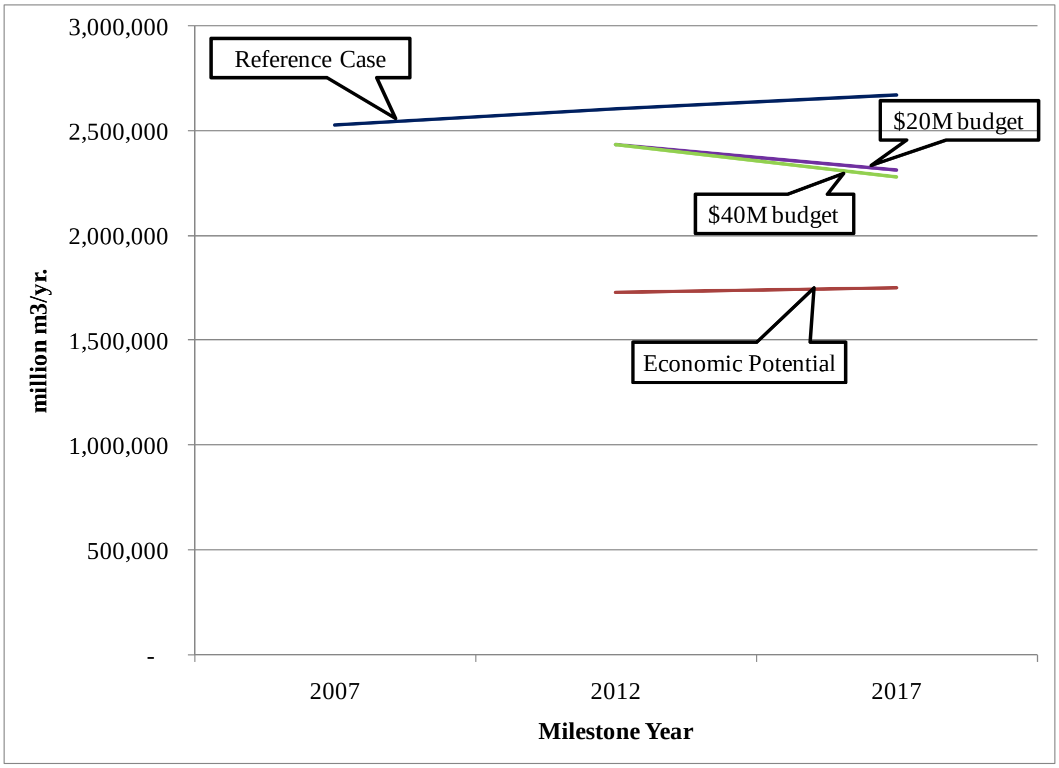


Exhibit 5.2: Summary of Forecast Results for the Total Enbridge Service Area - Annual Natural Gas Consumption, Industrial Sector (million m^3/yr)

Milestone Year	Annual Consumption in Industrial Sector (million m^3/yr)					
	Reference Case	Economic Potential	Achievable Potential			
			$20M Scenario*	$40M Scenario**	$60M Scenario	Financially Unconstrained
2007	2,530					
2012	2,604	1,726	2,433	***	***	2,433
2017	2,671	1,751	2,316	2,278	****	2,278

Exhibit 5.3: Summary of Forecast Results for the Total Enbridge Service Area – Achievable Natural Gas Savings in Milestone Years, Industrial Sector (million m^3/yr. and % Relative to Economic Potential Scenario)

Milestone Year	Natural Gas Savings (million m^3/yr., Relative to Economic Potential %)				
	Economic Potential	Achievable Potential			
		$20M Scenario*	$40M Scenario**	$60M Scenario	Financially Unconstrained
2012	877	171	***	***	171
2017	919	355	392	****	392
2012		19%	***	***	19%
2017		39%	43%	****	43%

Note**:** Natural gas savings in the milestone years represent the potential reduction in gas use in that year as a result of DSM measures implemented in the period.

* Estimated annual program costs for implementing all cost-effective measures is $3.1 million in 2012, moderately less than the $4 million allocated to the industrial sector in the $20 million DSM scenario. Results reported are for $3.1 million, and represent the maximum savings for the achievable scenario in 2012.

** Estimated annual program costs for implementing all cost-effective measures is $4.4 million in 2017, significantly less than the $8 million allocated to the industrial sector in the $40 million DSM scenario. Results reported are for $4.4 million, and represent the maximum savings for the achievable scenario in 2017.

*** Maximum measure implementation rates are achieved in the $20 million scenario in 2012. Based on the Achievable workshop results, no additional savings were identified in the $40 million, $60 million or Financially Unconstrained scenarios, while maintaining a positive TRC.

**** Maximum measure implementation rates are achieved in the $40 million scenario in 2017. Based on the Achievable workshop results, no additional savings were identified in the $60 million or Financially Unconstrained scenarios, while maintaining a positive TRC.

5.3 BASE YEAR NATURAL GAS USE

In the Base Year of 2007, the Industrial sector in Enbridge's total service area consumed about 2,529,979,000 m^3. This volume excludes natural gas used for power generation, co-generation and industrial feedstock, as these uses of natural gas are beyond the scope of this study.

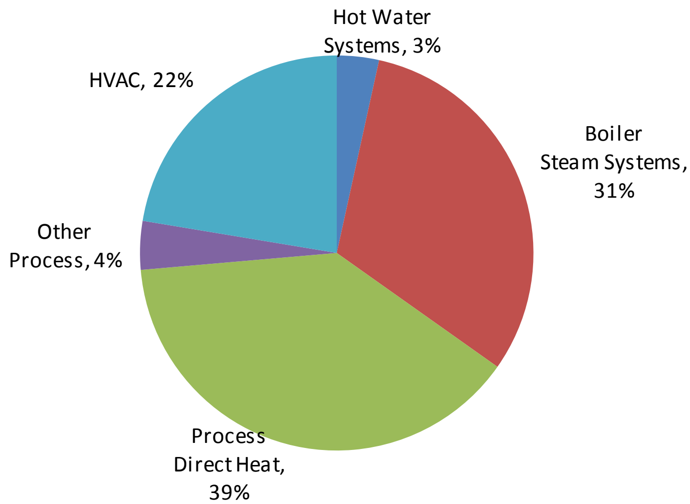
The 7 core industry sub sectors shown in Exhibit 5.4 account for 67% of the total industry natural gas consumption; 88% of the total industry natural gas consumption occurs in the central service region.

Exhibit 5.4: Base Year Industrial Sector Natural Gas Consumption for the Total Enbridge Service Area (1,000 m^3/yr.)

Sub Sector	End Use						
	Hot Water Systems	Boiler Steam Systems	Process Direct Heat	Other Process	HVAC	Total	Percentage of Total (%)
Non-metallic Mineral Product Mfg.	6,655	39,798	235,793	12,578	37,935	332,759	13%
Food Product Mfg.	26,125	156,162	89,772	20,214	34,289	326,563	13%
Paper Manufacturing	5,820	181,547	55,113	5,325	43,182	290,987	11%
Refined Petroleum & Coal	8,556	74,155	165,423	4,563	32,514	285,213	11%
Primary Metal	3,663	21,518	127,953	4,175	25,821	183,131	7%
Fabricated Metal	7,313	34,736	85,927	9,141	45,706	182,822	7%
Chemical	3,514	71,337	57,983	12,966	29,907	175,706	7%
Miscellaneous Mfg.	27,526	222,764	222,175	34,790	326,329	833,584	33%
Total	87,557	792,355	982,895	100,699	566,473	2,529,979	100%
Percentage	3%	31%	39%	4%	22%		

As illustrated in Exhibit 5.5 process direct heat accounts for about 39% of total industrial sector natural gas use. Boiler steam systems account for about 31% of the total natural gas use, followed by heating, ventilation and air conditioning (HVAC), which accounts for about 22%. Other processes and hot water systems account for the remaining natural gas consumption.

Exhibit 5.5: Base Year Industrial Sector Natural Gas Use for the Total Enbridge Service Area, by End Use



5.4 REFERENCE CASE

In the absence of new DSM initiatives, the study estimates that natural gas consumption in the Industrial sector will grow from 2,529,979,000 $m^{3/}$yr in 2007 to about 2,670,651,000 $m^{3/}$yr in 2017. This represents an overall growth of about 5.6% in the period and compares very closely with Enbridge's own forecast, which also includes consideration of the impacts of "natural conservation." Exhibit 5.6 shows the forecast levels of Industrial sector natural gas consumption for the entire Enbridge service area. The results are presented for each milestone year and sub sector.

Exhibit 5.6: Industrial Sector Reference Case Natural Gas Use for the Total Enbridge Service Area, by Sub Sector and Milestone Year (1000 m^3/yr)

	Eastern Region			Central Region			All Regions		
Sub Sector	**2007**	**2012**	**2017**	**2007**	**2012**	**2017**	**2007**	**2012**	**2017**
Non-metallic Mineral Product Mfg.	40,316	41,493	42,557	211,657	217,838	223,426	251,973	259,331	265,983
Food Product Mfg.	26,138	26,901	27,591	300,425	309,198	317,129	326,563	336,098	344,721
Paper Manufacturing	13,393	13,784	14,138	277,594	285,700	293,029	290,987	299,484	307,167
Refined Petroleum & Coal	16,091	16,561	16,986	269,122	276,980	284,085	285,213	293,541	301,071
Primary Metal	44,663	45,968	47,147	138,467	142,510	146,166	183,131	188,478	193,313
Fabricated Metal	18,290	18,824	19,307	164,533	169,337	173,681	182,822	188,161	192,988
Chemical	26,435	27,207	27,905	149,271	153,630	157,571	175,706	180,837	185,476
Miscellaneous Mfg.	121,869	125,428	128,646	711,714	732,496	751,287	833,584	857,924	879,933
Total	307,195	316,165	324,276	2,222,784	2,287,689	2,346,376	2,529,979	2,603,854	2,670,651

5.5 ASSESSMENT OF ENERGY EFFICIENCY MEASURES

The study assessed over 30 potential energy efficiency measures. A summary of the screening results for the energy-efficiency measures is presented in Exhibit 5.7. Due to the number of measures assessed for each sub sector the results shown are for the measures applied to a large technology group in the Chemical sub sector.

Exhibit 5.7: Summary of Measure TRC Screening Results — Example for Chemical Sub Sector, Large Technology Energy-efficiency Options

End Use	Measure	Full/ Incremental	Net Measure TRC	Simple Payback Period (Years)	Benefit/ Cost Ratio
System	Integrated control system	F	$ 772,955	0.8	5.3
	Sub metering, monitoring and targeting	F	$ 373,150	2.8	2.0
Boiler, Steam & Hot Water Systems	Economizers	F	$ 547,220	2.7	2.3
	Blowdown heat recovery	F	$ 207,457	3.3	1.8
	Boiler combustion air preheat	F	$ 570,854	3.2	1.9
	Heat recovery to preheat make-up water	F	$ 1,073,127	2.1	3.2
	Condensing boiler	I	$ 1,597,860	2.0	3.0
	Boiler right sizing and load management	I	$ 2,816,602	N/A	N/A
	High-efficiency burners	F	$ 734,121	2.5	2.6
	Insulation	F	$ 839,968	1.0	5.4
	Advanced boiler controls	F	$ 767,976	1.3	3.9
	Blowdown control	F	-$ 30,664	8.2	0.8
	Boiler water treatment	F	$ 83,769	1.8	2.1
	Boiler maintenance	F	$ 273,377	N/A	2.4
	Minimize deaerator vent losses	F	$ 339,472	2.3	2.8
	Condensate return	F	$ 258,722	4.4	1.5
	Steam trap survey and repair	F	$ 16,243	1.6	1.1
Process Heating (Furnaces/ Kilns/ Ovens/ Dryers)	Exhaust gas heat recovery	F	$ 5,159,494	1.0	5.4
	High-efficiency burners	F	$ 6,518,245	0.7	9.2
	Insulation	F	$ 1,283,871	1.0	5.3
	Advanced heating and process controls	F	$ 2,530,763	1.0	5.0
Other Process	Process heat recovery	F	$ 2,856,281	1.6	3.1
HVAC	Radiant heaters	F	$ 78,369	4.7	1.3
	Automated temperature control	F	$ 2,614	6.7	1.0
	Solar walls	F	-$ 69,729	10.2	0.7
	Ventilation optimization	F	$ 107,538	2.5	2.2
	Warehouse loading dock seals	F	-$ 15,800	6.3	0.7
	Air curtains	F	-$ 5,510	6.1	0.9
	Air compressor heat recovery	F	$ 136,353	3.1	2.1
	Destratification fans	F	$ 16,262	5.5	1.2
	Ventilation heat recovery	F	$ 113,925	2.8	2.0

5.6 ECONOMIC POTENTIAL FORECAST

Under the conditions of the Economic Potential Forecast,[26] the study estimated that natural gas consumption in the Industrial sector would decline to about 1,751,313,000 $m^{3/}$yr by 2017 for the total Enbridge service area. Annual savings relative to the Reference Case are about 919,340,000 $m^{3/}$yr by 2017, or about 34%. %. Further details are provided in Exhibits 5.8 and 5.9, which show the results by sub sector and end use for the milestone years 2012 and 2017, respectively.

Exhibit 5.8: Natural Gas Savings for the Total Enbridge Service Area by Sub Sector and End Use for the Milestone Year 2012, Reference Case vs. Economic Potential (1000 m^3/yr.)

	End Use							
Sub Sector	**System**	**Hot Water Systems**	**Boiler Steam Systems**	**Process Direct Heat**	**Other Process**	**HVAC**	**Total**	
Non-metallic Mineral Product Mfg.	9,505	886	8,797	29,511	784	17,187	66,669	8%
Food Product Mfg.	21,999	4,753	50,613	14,702	1,660	20,280	114,006	13%
Paper Manufacturing	14,467	1,016	52,389	8,505	433	25,486	102,296	12%
Refined Petroleum & Coal	10,759	1,461	22,620	26,589	374	20,290	82,094	9%
Primary Metal	6,908	755	7,345	20,401	344	15,828	51,583	6%
Fabricated Metal	12,316	1,526	11,808	14,487	751	25,749	66,637	8%
Chemical	7,496	611	20,765	9,516	1,067	17,889	57,344	7%
Miscellaneous Mfg.	31,445	5,018	68,431	37,341	2,862	191,669	336,766	38%
Total	114,896	16,026	242,768	161,052	8,275	334,379	877,394	100%
%	13%	2%	28%	18%	1%	38%	100%	

Exhibit 5.9: Natural Gas Savings for the Total Enbridge Service Area by Sub Sector and End Use for the Milestone Year 2017, Reference Case vs. Economic Potential (1000 m^3/yr.)

	End Use							
Sub Sector	**System**	**Hot Water Systems**	**Boiler Steam Systems**	**Process Direct Heat**	**Other Process**	**HVAC**	**Total**	
Non-metallic Mineral Product Mfg.	9,469	1,307	10,480	33,845	778	17,047	72,927	8%
Food Product Mfg.	22,201	5,956	54,287	15,367	1,645	20,071	119,526	13%
Paper Manufacturing	14,412	1,490	62,222	8,823	429	25,203	112,579	12%
Refined Petroleum & Coal	10,719	1,858	24,308	28,865	371	20,105	86,226	9%
Primary Metal	6,882	933	7,916	22,280	343	15,756	54,110	6%
Fabricated Metal	12,429	1,874	12,677	15,775	745	25,516	69,016	8%
Chemical	7,494	750	22,534	9,964	1,059	17,739	59,539	6%
Miscellaneous Mfg.	31,327	6,331	73,973	40,922	2,841	190,022	345,416	38%
Total	114,932	20,499	268,397	175,843	8,211	331,458	919,339	100%
%	13%	2%	29%	19%	1%	36%	100%	

5.6.1 Sensitivity Analysis

The Economic Potential results were subjected to a sensitivity analysis around two of the assumptions employed: Technology Cost and inclusion of a value for GHG emissions (as described in Step 5, in Section 1.4). The two sensitivity analyses offer the following insights:

[26] The level of natural gas consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost-effective. In this study, "cost-effective" means that the technology upgrade passes the measure Total Resource Cost (TRC) test, as discussed previously in Section 1.4.

- In the Industrial sector, the additional measures included in the technology cost sensitivity analysis provide only modest additional savings relative to the technologies already included in the Economic Potential Forecast.

- The sensitivity analysis identified potential savings of about 1,015 million m^3 in 2017; this compares with the identified savings potential of about 919 million m^3 in 2017 under the Economic Potential Forecast. Hence, the identified technical savings potential is about 12% greater than that identified in the Economic Potential Forecast.

- The GHG adder makes a relatively small difference to the overall avoided cost of energy.

5.7 ACHIEVABLE POTENTIAL

As noted previously, Achievable Potential was assessed from two perspectives:

- Potential Savings in Future Natural Gas Consumption Savings in one year due to the Aggregate impact of measures implemented over the time period of Base Year (2007) to Milestone Year (2012 and 2017). This method calculates the net change in future natural gas supply requirements.

- Potential DSM Program TRC Benefits. [27] Savings due to (only) those measures implemented in one year. This method is used in calculation of the net TRC benefits.

Within each of the above perspectives, the analysis of Achievable Potential was assessed under four different Marketing scenarios:

- One Financially Unconstrained scenario
- Three Financially Constrained scenarios, each limited by a different level of program budget availability.

Further detail related to each of the Marketing scenarios is provided below followed by a summary of results.

5.7.1 Financially Unconstrained DSM Marketing Scenario

The Financially Unconstrained scenario provides an overview of the level of potential natural gas savings that could be achieved if a comprehensive portfolio of DSM programs was launched without any constraint on the availability of program funding.

[27] The annual savings presented do not explicitly address the potential impact of free riders at the level of individual program measure. However, the Reference Case 3 does include an estimate of the impact of natural conservation over the study period, by end use (i.e., an estimate of natural gas savings that would occur in the absence of additional Enbridge DSM programs). Hence, the inclusion of natural conservation in the study's Reference Case does address some, but not necessarily all, free rider and spillover impacts. A more detailed assessment of free rider and spillover impacts is practical only as part of a detailed program design, which is beyond the scope of this study.

Although the results of this scenario are not constrained by program funding, the results do incorporate consideration of the market constraints identified during the Achievable Potential workshop, such as product and service availability and customer transaction costs.

This scenario, therefore, provides a high-level estimate of the upper level of natural gas savings that could be achieved by Enbridge's industrial customers over the nine-year period beginning in 2009 and ending in 2017. It also provides Enbridge's industrial DSM program personnel with a view of the relative potential contribution of individual sub sectors, end uses, technologies and service regions.

Major Assumptions: Financially Unconstrained Scenario

- All measures that pass the measure TRC screen are included
- No program financial limit is set, except that all measures must continue to pass the measure TRC screen
- Participation rates for each measure are based on the workshop results, which consider both market barriers and potential promotional strategies.

Exhibit 5.10 provides details on the program costs assumed for each measure.

Exhibit 5.10: Summary of Program Cost Assumptions, Financially Unconstrained Scenario[28]

End Use	Bundle	Measure Name	Fixed Program Costs ($/yr)	Incentive ($/m^3)	Payback After Incentive (yrs)[29]
System wide	1	Integrated control system	20,000	0.07	0.9
	2	Sub-metering	25,000	0.07	2.8
Boiler	3	Heat recovery to preheat makeup water	20,000	0.07	6.0
		Boiler combustion air preheat	20,000	0.07	9.8
		Minimize deaerator vent losses	20,000	0.07	5.8
		Blowdown heat recovery	20,000	0.07	6.6
		Boiler water treatment	20,000	0.07	4.3
		High efficiency burners	20,000	0.07	3.3
		Advanced boiler controls	20,000	0.07	2.7
		Economizer	20,000	0.07	3.8
		Weighted Average for Bundle 3	160,000		5.2
	4	Boiler right sizing and load management	20,000	0.07	-0.5
	5	Steam trap survey and repair	12,000	0.07	1.6
	6	Condensate return	25,000	0.07	5.9
	7	Insulation	20,000	0.07	1.8
	8	Boiler maintenance	20,000	0.07	2.3
	9	Condensing boiler	27,000	0.07	2.1
		Direct contact hot water heaters	27,000	0.07	-0.1
		Weighted Average for Bundle 9	54,000		0.5
Process	10	Exhaust gas heat recovery	32,500	0.07	4.1
		High efficiency burners	32,500	0.07	1.8
		Insulation	32,500	0.07	1.6
		Advanced heating and process controls	32,500	0.07	4.7
		Weighted Average for Bundle 10	130,000		2.9
	11	High-efficiency ovens	12,500	0.07	0.9
		High-efficiency dryers	12,500	0.07	0.7
		High-efficiency kilns	12,500	0.07	0.0
		High-efficiency furnaces	12,500	0.07	0.3
		Radiant tube burners	12,500	0.07	4.4
		Weighted Average for Bundle 11	62,500		0.3
Other	12	Process Heat Recovery	80,000	0.07	3.5
HVAC	13	Automated temperature control	30,000	0.07	6.4
		Air compressor heat recovery	30,000	0.07	5.4
		Radiant heaters	30,000	0.07	4.8
		Destratification fans	12,000	0.07	5.7
		Weighted Average for Bundle 13	30,000		4.6
	14	Ventilation Optimization	15,000	0.07	4.4
		Ventilation Heat Recovery	15,000	0.07	4.7
		Weighted Average for Bundle 14	30,000		4.6

[28] Salary and related overhead costs are not included in program cost estimates.

[29] The payback period is a weighted average payback period for the measures based on technology size distribution and gas consumption by sub sector.

5.7.2 Financially Constrained DSM Marketing Scenarios

These DSM Marketing scenarios provide estimates of the potential impacts of increasingly larger annual DSM budgets, which as noted previously were set at $20, $40 and $60 million, annually. Within each of these budgets, 20% of the funding is allocated to the Industrial sector for the purposes of this analysis.

The financially constrained scenarios include the following DSM costs:

- **Fixed Program Costs**: This includes costs for items such as newspaper advertisements, preparation of information and marketing materials, training workshops, contractor certifications, etc. These program cost elements are not expected to vary significantly if the number of installations of the measure changed. Estimates for these cost items were provided by Enbridge personnel, based on current and previous experience with similar DSM measures. In each case, these costs are expressed as dollars of program spending per year. For each of the measures, fixed program costs were estimated for both the CML and Financially Unconstrained Marketing scenarios. Salary and related overhead costs are not included.

- **Incentive Costs** (either end user or channel member): These costs would include any costs that vary directly according to the volume of gas saved by the measure. An incentive of \$ 0.05 / m^3 gas saved was used for the CML scenario and \$ 0.07 / m^3 gas saved for the Financially Unconstrained scenario. For each of the measures, incentive costs were estimated for both the CML and the Financially Unconstrained scenarios based on the volume of gas saved.

Exhibit 5.11 provides details on the program costs assumed for each measure.

Exhibit 5.11: Summary of Program Cost Assumptions, CML Scenario[30]

End Use	Bundle	Measure Name	Fixed Program Costs ($/yr)	Incentive ($/m^3)	Payback After Incentive (yrs)[31]
System wide	1	Integrated control system	15,000	0.05	0.9
	2	Sub-metering	10,000	0.05	2.9
Boiler	3	Heat recovery to preheat makeup water	15,000	0.05	6.2
		Boiler combustion air preheat	15,000	0.05	10.0
		Minimize deaerator vent losses	15,000	0.05	5.9
		Blowdown heat recovery	15,000	0.05	6.8
		Boiler water treatment	15,000	0.05	4.4
		High efficiency burners	15,000	0.05	3.4
		Advanced boiler controls	15,000	0.05	2.7
		Economizer	15,000	0.05	3.9
		Weighted Average for Bundle 3	120,000		5.3
	4	Boiler right sizing and load management	15,000	0.05	-0.5
	5	Steam trap survey and repair	8,000	0.05	1.6
	6	Condensate return	10,000	0.05	6.0
	7	Insulation	15,000	0.05	1.8
	8	Boiler maintenance	15,000	0.05	2.3
	9	Condensing boiler	8,000	0.05	2.1
		Direct contact hot water heaters	8,000	0.05	-0.1
		Weighted Average for Bundle 9	16,000		0.5
Process	10	Exhaust gas heat recovery	2,500	0.05	4.2
		High efficiency burners	2,500	0.05	1.9
		Insulation	2,500	0.05	1.6
		Advanced heating and process controls	2,500	0.05	4.9
		Weighted Average for Bundle 10	10,000		2.9
	11	High-efficiency ovens	2,500	0.05	0.9
		High-efficiency dryers	2,500	0.05	0.7
		High-efficiency kilns	2,500	0.05	0.0
		High-efficiency furnaces	2,500	0.05	0.3
		Radiant tube burners	2,500	0.05	4.4
		Weighted Average for Bundle 11	12,500		0.7
Other	12	Process Heat Recovery	2,000	0.05	3.6
HVAC	13	Automated temperature control	5,000	0.05	6.5
		Air compressor heat recovery	5,000	0.05	5.5
		Radiant heaters	5,000	0.05	4.9
		Destratification fans	10,000	0.05	5.8
		Weighted Average for Bundle 13	25,000		5.3
	14	Ventilation Optimization	10,000	0.05	4.5
		Ventilation Heat Recovery	10,000	0.05	4.8
		Weighted Average for Bundle 14	20,000		4.7

30 Salary and related overhead costs are not included in program cost estimates.

31 The payback period is a weighted average payback period for the measures based on technology size distribution and gas consumption by sub sector.

5.7.3 Achievable Potential Savings - Future Natural Gas Consumption[32]

Exhibits 5.12 to 5.14, inclusive, present a summary of the Achievable Potential savings in future natural gas consumption relative to the Reference Case levels. For illustration, the results of the Financially Unconstrained scenario are shown.

Selected highlights are provided below.

- Exhibit 5.12 shows that total industrial sector natural gas savings in 2017 are estimated to be approximately 392 million m^3/yr. This represents a savings of approximately 15%, relative to the Reference Case and is equal to approximately 43% of the savings identified in the Economic Potential Forecast. The Central service region accounts for about 87% of the identified potential.

- Exhibit 5.13 shows the results by sub sector for the entire Enbridge service area. As illustrated, the majority of savings in the unconstrained scenario are associated with the Miscellaneous Manufacturing sub-sector (39%), while the Food Product Manufacturing and Paper Manufacturing sub sectors each contribute approximately 12% each.

- Exhibit 5.14 shows the results by end use. As illustrated, measures applied to three end-uses, boiler steam systems, HVAC, and process heat, account for approximately 93% of the identified potential. Additional details describing the specific measures that contribute to these end-use savings are provided in the following sections.

Exhibit 5.12: Natural Gas Savings by Service Region and Milestone Year, Financially Unconstrained Scenario (1000 m^3/yr.)

Milestone Year	Eastern Region	Central Region	Total	% Savings Relative to Ref Case
	thousand m^3/year			
2012	21,055	149,446	170,501	7%
2017	49,817	342,337	392,155	15%
% Savings 2017 Re: Reference Case	15%	15%	15%	
% Savings 2017 Re: Total	13%	87%	100%	

32 See definition of savings as provided in Step 6, page 7.

Exhibit 5.13: Natural Gas Savings by Sub-Sector and Milestone Year for the Total Enbridge Service Area, Financially Unconstrained Scenario (1000 m^3/yr.)

Sub-Sector	Milestone Year		% Savings 2017	
	2012	2017	Re: Ref Case	Re: Total
	thousand m^3/year			
Non-metallic Mineral Product Mfg.	13,519	30,297	11%	8%
Food Product Mfg.	22,347	48,545	14%	12%
Paper Manufacturing	20,618	46,080	15%	12%
Refined Petroleum & Coal	16,873	37,382	12%	10%
Primary Metal	9,966	22,686	11%	6%
Fabricated Metal	11,473	27,278	14%	7%
Chemical	11,654	26,289	14%	7%
Miscellaneous Mfg.	64,051	153,598	17%	39%
Total	170,501	392,155	15%	100%

Exhibit 5.14: Natural Gas Savings by End Use and Milestone Year for the Total Enbridge Service Area, Financially Unconstrained Scenario (1000 m^3/yr.)

Sub-Sector	Milestone Year		% Savings 2017	
	2012	2017	Re: Ref Case	Re: Total
	thousand m^3/year			
Systems	2,062	13,331	0.5%	3%
Hot Water Systems	4,851	9,829	11%	3%
Boiler Steam Systems	60,858	121,470	15%	31%
Process Heat	40,989	81,921	8%	20%
Other Process	2,354	4,765	4%	1%
HVAC	59,388	160,839	27%	41%
Total	170,501	392,155	15%	100%

6.7.4 Potential DSM Program TRC Benefits

Exhibits 5.15, 5.16 and 5.17, present the results for the milestone year 2017. As illustrated, annual industrial program spending of approximately $4.4 million in 2017 would result in approximately 48 million m^3/year in natural gas savings[33] and approximately $44 million in TRC net benefits. The exhibits also illustrate that annual Industrial sector program spending achieves maximum results at an annual expenditure of $3.1 million in 2012, which is below the $4 million industrial budget, and $4.4 million in 2017, which is below the $8 million industrial budget. This is because additional cost-effective measures were not available under the conditions defined by these scenarios. Additional details are provided in the following exhibits.

33 Note: the savings shown are only for the measures installed in 2017; they do not include the savings in 2017 that occur as a result of measures installed in prior periods.

- Exhibit 5.15 presents the 2017 results by upgrade technology bundle, including both the current marketing level of participation and the increment from current marketing level to Financially Unconstrained. For each measure bundle, annual natural gas savings potential, net TRC benefits, and annual program costs are presented both individually and cumulatively. The measures are sorted in order of increasing program cost per dollar of TRC benefits.

- Exhibit 5.16 presents the 2017 results graphically, with program costs on the vertical axis and net TRC benefits on the horizontal axis.

- Exhibit 5.17 presents the 2017 results graphically, with program costs on the vertical axis and annual natural gas savings potential on the horizontal axis.

Exhibit 5.15: Summary Achievable Results** by Measure, for the Total Enbridge Service Area, 2017 Installations

Measure Bundle	Scenario	Annual Natural Gas Savings Potential (1000 m^3/yr)		TRC ($)		Annual Program Costs ($)		Program Costs per Unit	
			Cumulative		Cumulative		Cumulative	per Natural Gas Savings ($/$m^3$)	per TRC Benefits ($/$)
10	CML	2,668	2,668	4,618,451	4,618,451	143,384	143,384	0.05	0.03
1	CML	2,446	5,114	4,125,519	8,743,969	137,325	280,709	0.06	0.03
9	CML	83	5,197	490,517	9,234,486	20,135	300,843	0.24	0.04
12	CML	128	5,325	187,460	9,421,947	8,406	309,249	0.07	0.04
2	CML	719	6,044	1,020,872	10,442,819	45,945	355,194	0.06	0.05
4	CML	1,957	8,001	2,114,150	12,556,969	112,857	468,051	0.06	0.05
9	Unconstrained	221	8,222	1,297,911	13,854,880	71,104	539,155	0.32	0.05
2	Unconstrained	3,145	11,367	4,485,051	18,339,931	259,539	798,694	0.08	0.06
10	Unconstrained	5,704	17,071	9,766,933	28,106,864	582,651	1,381,344	0.10	0.06
4	Unconstrained	2,540	19,611	2,743,063	30,849,926	236,932	1,618,277	0.09	0.09
1	Unconstrained	864	20,475	1,441,935	32,291,862	129,397	1,747,673	0.15	0.09
14	CML	3,620	24,094	1,804,404	34,096,266	200,983	1,948,657	0.06	0.11
7	CML	836	24,931	398,624	34,494,890	56,804	2,005,461	0.07	0.14
6	CML	199	25,130	130,800	34,625,690	19,958	2,025,419	0.10	0.15
3	CML	4,040	29,170	2,049,997	36,675,687	322,009	2,347,427	0.08	0.16
14	Unconstrained	7,252	36,422	3,625,066	40,300,753	610,016	2,957,443	0.08	0.17
12	Unconstrained	435	36,856	562,594	40,863,347	112,978	3,070,421	0.26	0.20
7	Unconstrained	952	37,808	450,738	41,314,085	103,328	3,173,750	0.11	0.23
13	Unconstrained	1,509	39,316	551,741	41,865,826	143,295	3,317,044	0.09	0.26
6	Unconstrained	302	39,619	188,824	42,054,650	50,154	3,367,198	0.17	0.27
3	Unconstrained	3,635	43,254	1,792,452	43,847,103	495,264	3,862,462	0.14	0.28
11	CML	360	43,614	50,063	43,897,166	30,486	3,892,948	0.08	0.61
8	CML	295	43,909	43,751	43,940,916	29,775	3,922,723	0.10	0.68
13	CML	634	44,544	140,538	44,081,454	133,722	4,056,445	0.21	0.95
8	Unconstrained	307	44,851	41,068	44,122,522	47,411	4,103,856	0.15	1.15
11	Unconstrained	938	45,788	100,593	44,223,116	135,337	4,239,193	0.14	1.35
5	CML	941	46,730	13,048	44,236,164	55,073	4,294,266	0.06	4.22
5	Unconstrained	1,308	48,038	17,243	44,253,407	122,390	4,416,656	0.09	7.10
				Weighted Average (@ $4M Industrial spending):				0.09	0.09
				Weighted Average (total):				0.09	0.10

** Savings shown are incremental to those for preceding measures.

Exhibit 5.16: Achievable Potential Supply Curve, 2017: Program Cost vs. TRC Net Benefits, for the Total Enbridge Service Area

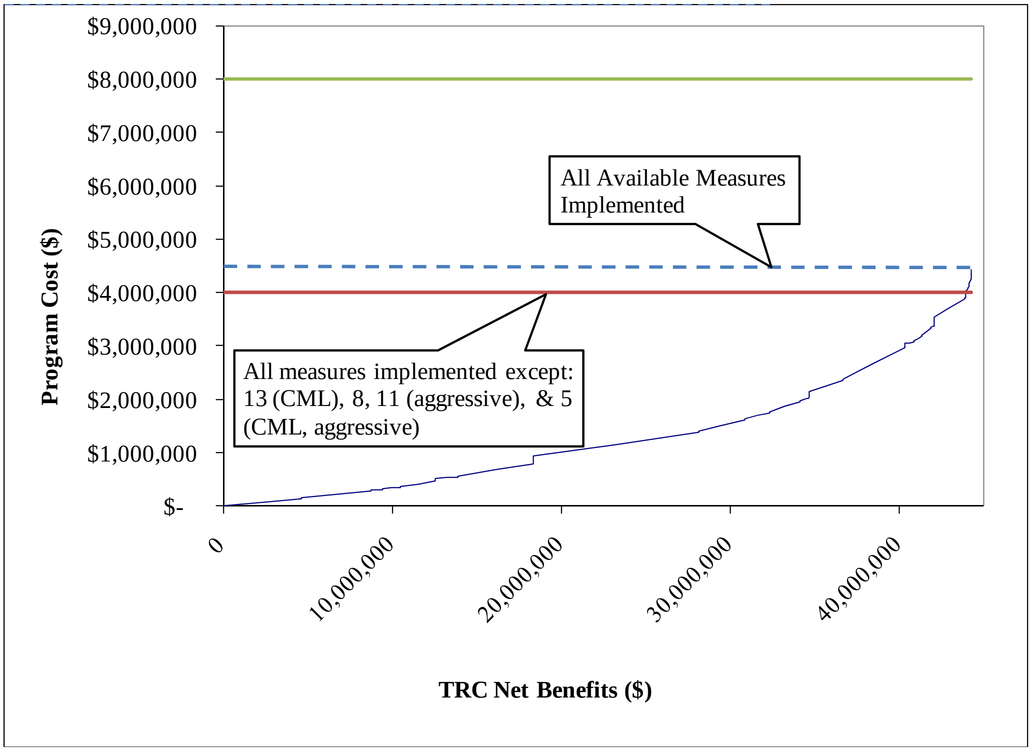
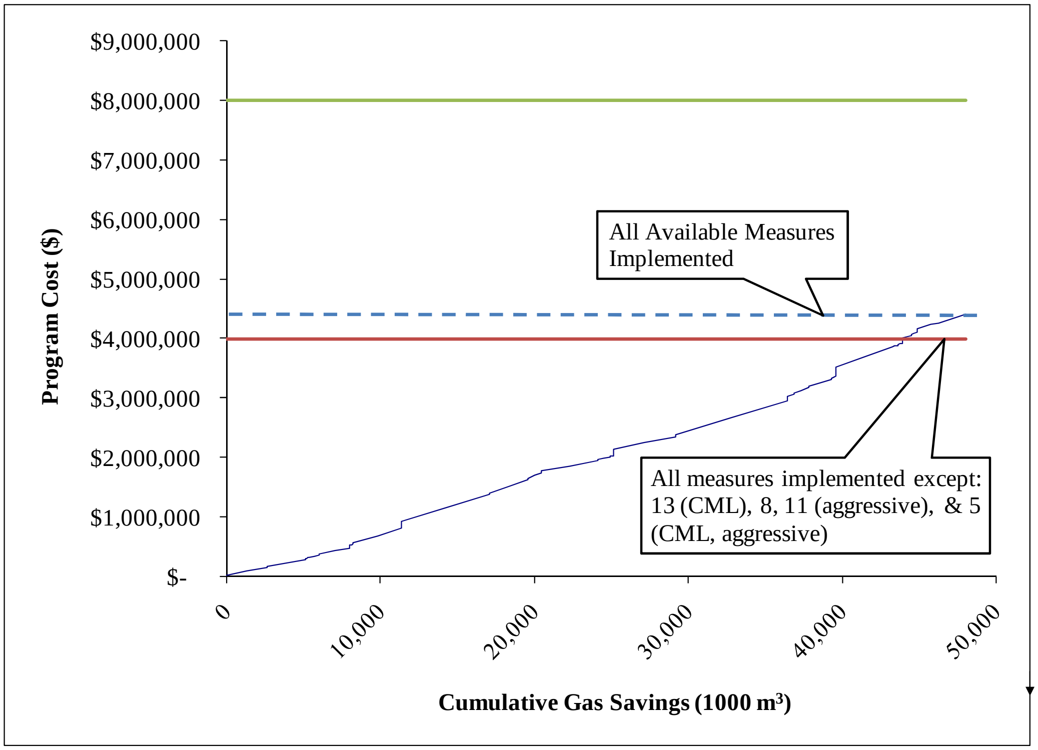


Exhibit 5.17: Achievable Potential Supply Curve, 2017: Program Cost vs. Annual Natural Gas Savings Potential, for the Total Enbridge Service Area



5.7.5 Conclusions

Selected highlights are provided below.

- Annual Industrial sector program spending achieves maximum results at an annual expenditure of $3.1 million in 2012, which is below the $4 million industrial budget, and $4.4 million in 2017, which is below the $8 million industrial budget. This is because additional cost-effective measures were not available under the conditions defined by these scenarios.

- With industrial program spending of approximately $4.4 million in 2017, program costs are approximately $0.09 per gross m^3 of natural gas savings and $0.09 per dollar of gross TRC benefits. This compares with recent Enbridge monitoring and evaluation results[34] of $0.06/$m^3$ of gross natural gas savings ($0.07/$m^3$ net of free riders).

- Program costs per dollar of TRC net benefits are particularly attractive for the following measure bundles:
  - Bundle 10 – Retrofitting ovens, dryers, kilns and furnaces to improve efficiency, such as exhaust gas heat recovery, high efficiency burners, insulation and advanced heating and process controls
  - Bundle 1 – System wide integrated control systems
  - Bundle 9 – Upgrading to more efficient boilers and heaters, such as condensing boilers and direct contact hot water heaters
  - Bundle 12 – Process heat recovery
  - Bundle 2 – System wide sub-metering
  - Bundle 4 – Boiler right sizing and load management

5.8 ADDITIONAL OBSERVATIONS

In addition to the preceding conclusions, two additional observations warrant note as they may affect future Industrial sector program strategies. They include:

- ***Rate of measure implementation has a large effect on overall savings:*** For measures that pass the TRC screen on an incremental cost basis, low participation rates in early milestone years create a significant "lost opportunity." This is particularly relevant to the replacement of equipment with a very long life, which is applicable to most industrial technologies and measures. The gap between Economic Potential and Achievable Potential savings presented in this study is due in large part to the significant lost opportunity that occurs in early milestone years.

- ***Bundling of measures to develop program concepts has an impact on the achievable potential and program development:*** To model the achievable potential scenario measures were grouped into bundles that are manageable within the scope and budget of the project. The Achievable results provide an indicative savings potential based on the

[34] Enbridge Gas, 2007 LRAM Post Audit Results.

specific set of bundles. Savings from individual measures, or different bundle mixes of measures, will vary.

GLOSSARY

achievable potential
The Achievable Potential is the proportion of the natural gas savings identified in the Economic Potential Forecast that could realistically be achieved within the study period. Achievable Potential recognizes that it is difficult to induce customers to purchase and install all of the efficiency technologies that meet the criteria defined by the Economic Potential Forecast.

avoided cost
The unit cost of acquiring the next resource to meet demand, which is used as a measure for evaluating individual demand-side and supply-side options. In the context of this study "avoided cost" is the capital expenditure offset by Enbridge's DSM activities (i.e., the cost of having to buy natural gas on the open market, contract for long-term supply, and the cost of associated transmission and storage.

base year
The Base Year is the year to which all potentials will be compared. It provides a detailed description of "where" and "how" natural gas is currently used in each sector. For this study, it is the calendar year 2007. The modelled base year energy use is calibrated against Enbridge's actual sales for 2007.

benefit/cost ratio
The measure benefit/cost ratio indicates the relative attractiveness of the measures. A measure that has a benefit/cost ratio in excess of 1.0 has benefits which outweigh its costs. Similarly, a measure with a benefit/cost ratio that is well in excess of one (e.g., 3.0) means that it is very attractive. A measure with a benefit/cost ratio of less than 1.0 has costs which outweigh its benefits.

building envelope
The material separation between the interior and the exterior environments of a building. The building envelope serves as the outer shell to protect the indoor environment as well as to facilitate its climate control.

british thermal unit or BTU
The standard measure of heat energy. It takes one Btu to raise the temperature of one pound of water by one degree Fahrenheit at sea level

co-generation
The simultaneous production of electric or mechanical energy and useful heat energy from a single fuel source.

combustion efficiency
The ratio of energy released during combustion to the potential chemical energy available in the fuel.

demand-side management (DSM)
Actions taken by a utility or other agency which are expected to influence the amount or timing of a customers energy consumption.

discount rate
The interest rate used in calculating the present value of expected yearly benefits and costs.

economic efficiency
Allocation of human and natural resources in a way that results in the greatest net economic benefit, regardless of how benefits and costs are distributed within society.

economic potential forecast
The economic potential forecast is an estimate of the level of natural gas consumption that would occur if all equipment and building envelopes were upgraded to the level that is cost effective from society's perspective. All of the energy-efficiency technologies and measures that have a positive measure TRC are incorporated into the economic potential forecast. These technologies and measures are applied at either natural stock turnover rates or at designated years for immediate application.

energy audit
An on-site inspection and cataloguing of energy using equipment/buildings, energy consumption and the related end-uses. The purpose is to provide information to the customer and the utility. Audits are useful for load research, for DSM program design and for identification of specific energy savings measures.

energy conservation
Activities by energy users that result in a reduction of the energy used to provide services. Energy conservation can include a wide variety of behavioural or operational changes that result in energy savings..

Energy efficiency
Using less energy to perform the same function. For the purpose of this study, only energy savings achieved through physical or hardware installations are considered.

energy intensity
The ratio of energy consumed per application or end use. For example, cubic metres per square metre of heated office space per day, or cubic metres per tonne of aluminum produced. All else being equal, energy intensity increases as energy efficiency decreases.

emerging technologies
New energy-conserving technologies that are not yet market-ready, but may be market-ready over next 5 to 10 years. This category includes technologies that could be accelerated into the market during that period through targeted financial or technical support.

end use
The final application or final use to which energy is applied. End use is often used interchangeably with energy service.

energy savings
The reduction in use of energy from the pre retrofit baseline to the post retrofit energy use that result from efficient technologies or activities. In this document, the term "energy" refers specifically to energy derived from natural gas unless otherwise noted.

energy service
An amenity or service supplied jointly by energy and other components/equipment such as buildings and heating equipment. Examples of energy services include residential space heating, commercial cooking, aluminum smelting and public transit. The same energy service can frequently be supplied with different mixes of equipment and energy.

energy use index (EUI)
End use energy consumption divided by a specific parameter of production (e.g., m^3/unit)
environmental credit/environmental penalty
An increment or decrement to the cost of a resource or set of resources, to reflect the overall level of its/their environmental impact, relative to another resource or set of resources.

financial incentive
Certain financial features in the utility's DSM programs designed to motivate customer participation. They may include features designed to reduce a customer's net cash outlay, pay-back period or cost of finance to participate.

fuel share
The proportion of requirements for a specific service that is met using a certain fuel. In the Commercial sector, fuel shares are normalized on a floor area basis. For example, a natural gas fuel share of 90% for space heating in the Large Office sub sector implies that 90% of the sub sector floor space is heated using natural gas.

free rider
A program participant who would have implemented the program measure or practice in the absence of the program.

interactive effects
In the context of natural gas use, interactive effects refer to the increase in gas consumed by heating equipment required to offset a decrease in "waste" heat generated by more efficient electrical fixtures or appliances after retrofit or replacement.

kilowatt (kW)
One thousand watts; the most common unit of measurement of electric power. (The amount of energy transferred at a rate of one kilowatt for one hour is equal to one kilowatt hour.)

kilowatt hour (kWh)
The most common unit of measurement of electric energy. One kilowatt hour represents the power of one thousand watts for a period of one hour.

load forecast
An estimate of expected natural gas requirements that have to be met by the utility in future years.

load research
Research to disaggregate and analyze patterns of natural gas consumption by various subsectors and end-uses. Load Research supports the development of the load forecast and the design of demand-side management programs.

market transformation
A reduction in market barriers resulting from a market intervention, as evident by a set of market effects that lasts after the intervention has been withdrawn, reduced or changed.

measure total resource cost (TRC)
The Measure TRC is the net present value of energy savings that result from an investment in a energy efficiency measure. The Measure TRC is equal to its full or incremental capital cost (depending on application) plus any change (positive or negative) in the combined annual energy and operating & maintenance costs. This calculation includes among others, the following inputs: the avoided natural gas, electricity and water; the life of the measure; and the selected discount rate.

natural conservation
The future change in energy intensity or base usage that is expected to occur in the absence of utility DSM programs. Natural change represents the effects of energy related decisions that would have been made in the absence of the utility programs by both program participants and non-participants

Non-participant:
Any customer who was eligible but did not participate in the utility program under consideration in a given program year.

non-participant test (NPT)
A test measuring what happens to rates due to changes in utility revenues and operating costs caused by a program. Rates will go down if the avoided cost is greater than the sum of the revenue lost plus the program costs. This test indicates the direction and magnitude of the expected change in rate levels.

participant
An individual, household, business or other utility customer that received a service or financial assistance orffered through a particular utility program, set of utility programs or particular aspect of a utility program in a given program year.

rate
Generically refers to a utility's rate structure.

rate structure
The formulae used by a regulated gas utility to calculate charges for the use of natural gas..

rebates
A type of incentive provided to encourage the adoption of energy efficeing practices, typically paid after the measure has been installed. There are typically two types of rebates: a Prescriptive Rebate, which is a prescribed financial incentive/unit for a prescribed list of products and a

customized rebate in which the financial incentive is determined using an analysis of the customer equipment and an agreement on the specific products to be installed.

reference case forecast
An estimate of the expected level of natural gas consumption that would occur over the study period in the absence of any new utility DSM market interventions after 2008. It is the baseline against which the scenarios of energy savings are calculated. The Reference Case forecast incorporates an estimation of "natural conservation," namely, changes in end-use efficiency over the study period that are projected to occur in the absence of new market interventions by the utility.

retrofit
Energy efficiency activities undertaken in existing residential or non residential buildings where existing inefficient equipment is replaced by efficient equipment.

saturation
The portion of floor area that receives a specific energy service. For example, a saturation of 86% for space cooling in the Large Office sub sector means that 86% of the sub sector floor space is cooled (regardless of fuel used to provide that cooling).

seasonal efficiency
The ratio of delivered useful energy relative to the input potential fuel energy determined over a full heating season (or year).

sector
A group of customers having a common type of economic activity. Enbridge Gas divides its customers into three principal sectors: Residential, Commercial and Industrial. Sectors are further divided into subsectors. For example, "Large Offices" is a sub sector of the Commercial sector.

service area
The portion of the Province of Ontario that receives service from Enbridge Gas.

service region
For the purposes of this study, the total Enbridge Gas service area is divided into two service regions. They are the Southern Region and the Eastern Region.

simple payback
The simple payback is generated to show the customer's financial perspective. Simple payback is a measure of the length of time required for the cumulative savings from a project to recover its initial investment cost, without taking into account the time value of money

strategic load growth
Utility action to increase (annual) total natural gas demand for specific end uses.

sub sectors
A classification of customers within a sector by common features. Residential subsectors are by type of home (SFD, duplex, apartment, etc.). Commercial subsectors are generally by type of

commercial service (office, retail, warehouse, etc.). Industrial subsectors are by product type (pulp and paper, solid wood products, chemicals, etc.).

supply curves
A curve illustrating the amount of energy (e.g., m^3) or societal benefit available at an appropriate screened price in ascending order of cost.

Total Resource Cost (TRC) Test
A test that compares the total costs of energy efficiency investments, including natural gas conservation programs, to the social cost of natural gas. Un-priced environmental and social costs may be accounted for by changing the cost of either the investment under consideration or the total cost of natural gas in such a way that relative un-priced impacts are reflected. It is used in designing and evaluating programs that are developed from the Energy Efficiency Potential study's results.

utility cost
The total financial cost incurred by the utility to acquire energy resources. For DSM, the costs include all utility program costs, including incentive costs.

watt
The basic unit of measurement of power, at a point in time as capacity or demand.

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Enbridge DSM Strategy Development

Stakeholder Roundtable Workshops

Summary Report
January, 2011

This summary report was prepared by Lura Consulting, the independent facilitators for the Enbridge Stakeholder Roundtable Workshops. It captures and presents the key discussion points brought up during seven stakeholder engagement sessions as part of the development of Enbridge's Demand Side Management Strategy for 2012 and beyond. The workshops took place in Toronto at the BMO Institute for Learning over the course of seven days from December 3 to December13, 2010. If you have any questions or comments regarding the summary, please contact:

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1 Stakeholder Roundtable Workshops

1.1 Context

Enbridge Gas Distribution (Enbridge) serves over 1.9 million customers in its Ontario service areas, including residential, commercial/institutional and industrial customers. Enbridge initiated several energy efficiency programs on its own initiative prior to the 1993 Energy Board Order (EBO 169). The first Demand Supply Management (DSM) program was rolled out in 1995 under the new OEB directive that now supports the Province's conservation and energy efficiency goals (2020 and 2050 Greenhouse Gas reduction targets) as spelled out in Ontario's 2007 Action Plan on Climate Change.

The DSM portfolio consists of four generic program types: Resource Acquisition, Market Transformation, Low Income and Development programs. Enbridge has developed multiyear programs in each of these areas that have steadily increased gas savings and avoided 9.9 million tonnes (1995 – 1999) of Greenhouse Gas emissions in Ontario since the first DSM programs were launched.

1.2 Overview of the DSM Strategy Development

Enbridge continues to be a leader in DSM programs in Ontario and has an established track record of consulting with stakeholders as part of developing and implementing DSM programs. In December 2010, Enbridge launched an initiative to consult with stakeholders in a variety of sectors on the development of sector strategies and program designs for as part of a multiyear DSM Plan for the 2012 to 2017 period. The DSM strategy for 2012 and beyond must lead to deep and lasting energy use reduction, provide flexibility to adapt to changing needs and conditions, and provide for a fair incentive to the utility while also being simple, straightforward and focused.

Enbridge believes that the overarching goal of the 2012 DSM plan can be achieved through effective and ongoing consultation with key sectoral stakeholders to effect transformative change with gas customers.

1.3 Stakeholder Roundtable Workshops

1.3.1 Purpose

In December, 2010, Enbridge hosted a series of sector-based roundtable workshops with Enbridge customers and stakeholders to discuss the strategic framework and preliminary directions for DSM programs from 2012-2017. Specifically, the workshops were designed to:

- Hear ideas from sector representatives on Enbridge energy efficiency plans, projects, and initiatives.
- Share ideas on a new approach for Enbridge's energy efficiency programs.
- Explore how Enbridge can best help customers in each sector realize further energy efficiency gains.

1.3.2 Participation

In order to gain feedback that reflects the needs of their customer base, Enbridge hosted a series of seven roundtable workshops with representatives from diverse market segments.

The following workshops were held from December 3 – December 13, 2010 at the BMO Institute for Learning in Toronto, Ontario:

- **Industrial Sector** – Friday, December 3rd
- **Small Commercial Sector** – Monday, December 6th
- **Commercial Sector** – Tuesday, December 7th
- **Residential Existing Homes Sector** – Wednesday, December 8th
- **Large New Construction Sector** – Thursday, December 9th
- **Residential New Construction Sector** – Friday, December 10th
- **Municipal Sector** – Monday, December 13

1.3.3 Format

The workshops were facilitated by Mr. Jim Faught and Mr. David Dilks of Lura Consulting. At 8:30 a.m., the facilitators welcomed participants to the workshop, briefly described the purpose of the workshops, and walked participants through the meeting agenda and workbook. A sample copy of a workbook is provided in Appendix A.

After workshop attendees were introduced to each other, they were formally greeted to the session by Enbridge. An Enbridge representative provided participants with a broad overview of the organization's involvement and success in implementing DSM programs over the past fifteen years. Participants were also informed of the need to continue to adapt existing programs and develop new DSM initiatives that will address the changing market conditions in Ontario's energy efficiency landscape. To accomplish this, the Enbridge representative emphasized the importance of collaborating with stakeholders throughout the planning process.

Afterward, the facilitators led attendees in an activity that encouraged participants to "think outside the box" and "dream big." Attendees were asked to envision "a perfect Ontario where energy efficiency is engrained in our culture and DSM programs are being utilized by all market segments." Upon reflection, individuals were asked to share 1-2 main points with the group that best described their desired future state. Below is a list of recurring themes from the ice breaker activity:

- Collaboration and a shared vision among utilities
- Increased awareness/education
- Integrated/holistic energy efficiency programs
- Net zero energy consumption
- Improved measurement/data analysis
- Improved communication and messaging
- Utilization of multiple/diverse renewable energy sources
- Systems approach to energy efficiency

Next, an Enbridge representative delivered a short background presentation that provided participants with an understanding of Enbridge's role in DSM and the organization's success in helping their customers achieve both long and short term energy efficiency targets. The presentation outlined the current energy efficiency landscape in Ontario and emphasized the important role that DSM programs will play in helping the Province achieve GHG emission reduction targets in the future. Further, the presentation summarized Enbridge's preliminary Green Energy Strategy and Energy Efficiency Strategy for the period of 2012 and beyond.

Following the workshop presentation, Lura facilitated a two-part discussion with workshop participants about Enbridge's proposed approach and strategy for DSM programs (*Part A: Approach and Strategy*) and the utility's preliminary strategy for implementation (*Part B: Going Forward – Strategy Implementation*).

During and after each session, stakeholders were encouraged to provide feedback through workbooks that were provided to all participants. Attendees were also invited to stay following the workshop and discuss energy efficiency further with Enbridge staff members and their peers in a more informal setting. Participants were also encouraged to submit any additional comments to Enbridge following the event via email, fax, mail, or through setting up a meeting with Enbridge staff.

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2 Recurring Themes

Throughout the seven workshops a number of themes emerged from the comments received from stakeholders.

The following section provides a high level summary of these recurring themes. A more detailed account of the comments received at the individual workshops can be found in the sector by sector chapters that follow.

Integration and Collaboration:

- It is crucial for gas, electric, and water utilities to collaborate and provided a one-window portal for energy efficiency.
- Municipalities can act as strategic partners for Enbridge by assisting with program development and community engagement.
- Enbridge should team up with other utilities to advocate for a consistent voice for energy efficiency in the Province, further reform to the Ontario Building Code, and a simplified energy rating system.
- Enbridge should focus resources on engaging key organizations and customers (e.g. contracting and trade associations, large new home builders) that have the ability to spur market transform and broader cultural change.

Long-term and Consistent Strategies

- Enbridge's long term approach and strategy has the right focus for achieving deep savings and cultural change.
- Spurring cultural change and market transformation takes a significant amount of time. There is a need for the Ontario Energy Board to recognize this.
- Funding for energy efficiency programs needs to remain consistent across the Province. To date, customers do not know if incentives and programs will be offered in the future as programs may be affected by changes in the political environment.

Public Awareness

- At this point in time, carbon footprint reduction is not a priority for Enbridge customers. Customers are predominately concerned about return on investment, profitability, and financial security.
- Energy efficiency messaging needs to be simplified and easy to understand.
- Providing case studies that highlight best practices and new technologies/products would be a valuable way to increase awareness.
- Enbridge is a well-respected organization that has had a long history of working in local communities. The utility can play an important role in providing customers with credible and objective information about energy efficiency.
- Community-wide retrofit programs would an effective way to increase awareness, achieve economies of scale, and spur local cultural/behavioural change in regards to energy efficiency.

Building Capacity:

- Enbridge should help building owners and operators understand how to manage their buildings using a systems approach to total building performance.
- Enbridge should provide training to key energy efficiency enablers (e.g. building operators, contractors, suppliers, and residential sales representatives).

- Billing information is not a sufficient way to monitor energy consumption. Enbridge should provide customers with assistance collecting and synthesizing real-time data.
- Building operators need to be trained on how to properly maintain and operate building equipment.

Decision-making Drivers:

- Return on investment and profitability are key motivators for adopting energy efficiency best practices.
- Customers are interested in energy efficiency but there are budgetary constraints that are preventing the adoption of energy efficient technologies.
- Monitoring gas consumption and data analysis is an essential component for building the business case for energy efficiency.
- More incentives are needed if Enbridge wants to encourage customers to purchase more expensive equipment.

Accountability

- Energy efficiency benchmarking is needed to encourage competition within the industry and highlight energy efficiency champions.
- There is a need for third-party auditing to ensure building are commissioned and maintained properly.
- There needs to be better accountability for testing new equipment and technologies.
- Enbridge should lead research and pilot projects to provide customers with reliable and accurate information.

3 Industrial Sector

The following section provides a summary of the comments received from workshop participants during the industrial sector workshop. A more detailed account of the comments received can be found in Appendix B.

Key Priorities for Industrial Clients

- Providing roving energy solutions consultants/energy managers to smaller industrial clients.
- Providing energy monitoring and measurement assistance (e.g. subsidizing gas metering systems).
- Enbridge should work with energy providers to form a one-window approach to energy efficiency.
- Obtaining assistance with the preparation of business plans for new energy efficiency strategies (e.g. energy management plans ROI calculations).
- Establishing training and networking events for professionals to learn about best practices, industry standards, and success stories.

Comments on the Proposed Strategy

- The 'low hanging fruit' has been implemented. Plant managers are running out of ideas to further reduce energy consumption.
- Enbridge will have to take a long-term approach to DSM (e.g. preparation of energy management plans and studies, pilot projects, etc.) in order to help its customers find opportunities for deep savings.
- There is a lack of awareness in the industry sector. Educational initiatives, such as websites, training, symposiums/events, will help Enbridge customers build the capacity to address energy consumption patterns and habits.
- "If you can't measure it, you can't save it." Monitoring, data analysis, and recomissioning are key for Enbridge customers to achieve long-lasting results and deep savings.

DSM Planning – 2012 and beyond

Customer Needs

- Enbridge provides superior levels of support and technical expertise to its customers on how to adopt and maintain energy efficiency practices in an industrial plant.
- Enbridge should assist industrial clients in preparing energy management studies to find opportunities for increased savings.
- Smaller industries need help with monitoring, collecting, and analyzing gas consumption data.
- Providing assistance when conducting sensitivity analysis for energy costs would be valuable for customers that are taking a long-term planning approach.

New DSM Initiatives

Customer Support Initiatives

- Enbridge should consider the viability of assisting customers in calculating their carbon footprint.
- Monitoring gas consumption and data analysis is an essential component to understand the need for adopting best practices.
- Enbridge should explore the option of supplying customers with gas meters to monitor gas consumption on older equipment that would not otherwise warrant the purchase of a gas meter.

- There needs to be an integration of electric and gas energy efficiency programs. Customers are confused because they are bombarded with messages from too many sources.
- Enbridge should explore the option of providing smaller industrial clients with roving energy engineers that would visit plants for short periods of time and help identify energy efficiency projects.
- Enbridge should create a website/forum where customers can find information on Enbridge programs and incentives. Hosting other information on grants, tax rebates, case studies, and best practice research would also be valuable to industrial clients.
- Enbridge should explore the potential of providing clients with advice for how to capitalize on tax investments in order to help build the business case for energy efficiency.
- Enbridge should provide funding to customers to regularly service their gas equipment. Many facilities do not regularly service and maintain their equipment.
- Enbridge should offer industrial clients assistance with preparing the business case for new energy efficiency strategies and technologies.
- Piloting new technologies and helping clients test new equipment would be extremely valuable for industrial clients who are reluctant to invest in unproven technologies.
- Educating customers about the importance of equipment reconditioning and maintenance would be an easy way to save energy in the plant.

Carbon Footprint and Emission Reduction Programs

- Carbon footprint reduction is not top of mind for industrial customers. Return on investment and profitability is their primary concern.
- Large facilities generally have an energy management plan to achieve cost savings. Carbon footprint reduction is generally used for marketing purposes.
- Carbon footprint calculating is very important in Europe and will likely pick up steam in North America in the near future.
- Until there is a price for carbon, GHG reduction will not be a driving factor for energy efficiency.

Renewable Energy

- Industrial clients would be more interested in wind and solar energy projects if the return on investment was improved through incentive programs.
- Some industrial plants are considering co-generation facilities. However, decisions that require significant investment are made at central offices, not on site by facility managers or energy managers.
- Renewable energy projects come down to return on investment and cost savings.
- Industrial clients are open to biogas production. Enbridge could play a role in helping conduct research and pilot projects.
- A feed-in-tariff program similar to the one used for solar electricity should be developed for solar heating systems. If the payback period was shorter, many industrial manufacturers would be interested in the technology.

Promotion of Energy Efficiency

- Industry benchmarking would be an effective way to highlight early adopters and energy champions. This could help spur overall market transformation.

- Industry associations are key communication channels that could be used by Enbridge (e.g. Canadian Association of Manufacturers and Exporters).
- Equipment suppliers are key messengers for Enbridge programs and projects. Enbridge should educate suppliers and installers to ensure they know what initiatives/incentives are available to industrial clients.
- Providing examples of new projects or initiatives undertaken by some industrial clients in bill mailings would be a valuable way of educating plant operators.
- At the industrial level, executives are the key decision makers for purchasing new technologies that are expensive. Enbridge should engage leaders of industrial companies on a peer-to-peer basis to encourage more significant organizational change and investment in energy efficiency.
- Hosting sector wide symposiums and forums would be an effective way to reach out to industrial clients and encourage discussion about energy efficiency best practices.
- Success stories should be shared amongst industrial clients to increase awareness about new technologies and energy conservation strategies that have worked for other industrial clients.

Capacity Building and Training

- Energy engineers and plant managers need further training and education about new technologies and energy efficiency strategies.
- It is crucial that information about best practices and new technologies is shared within the industry.
- Enbridge is a well trusted and respected organization in the industry sector. They can play an important role in providing accurate/reliable information for their customers about energy efficiency.
- Hosting webinars and training for energy engineers and plant managers would be a valuable tool for continuous improvement and professional development.

Partnership Building

- Enbridge should collaborate with LDCs and NRCAN to provide training and deliver energy management workshops to plant managers/operations.
- Enbridge is a credible and trusted organization. It should help lead conservation programs for both gas and electric utilities to ensure programs have a unified message.
- It is important for energy providers (Gas, Hydro, and Water) to align their projects and priorities with simplified energy efficiency messaging.

Comments on Existing DSM Programs

- Incentives for industrial clients should be scaled appropriately to reflect the cost for purchasing new equipment that can be particularly expensive.
- The majority of industrial customers are looking for a three-five year payback for implementing any new technology or energy efficiency measure.
- Enbridge should explore the viability of targeting specific sectors of industrial clients where they can educate them about their programs and best practices (i.e. automotive, food processing, etc.)

4 Small Commercial Sector

The following section provides a summary of the comments received from workshop participants during the small commercial sector workshop. A more detailed account of the comments received can be found in Appendix C.

Key Priorities for Small Commercial Clients

- There should be a one-window, collaborative approach to energy efficiency in Ontario.
- Building owners and operators need to be trained on how to effectively commission and use new energy efficiency equipment.
- Industry messaging to the commercial market should be through channel partners (e.g. contractor associations).
- It would be valuable for Enbridge to develop a database/catalogue of best practices and case studies of success stories in the commercial market.
- Providing forums for businesses to talk about best practices and success stories would be an effective way to educate customers and encourage benchmarking in the industry.

Comments on the Proposed Strategy

- The marketplace takes a long time to recognize the value of adopting new technologies and energy efficiency strategies. Therefore, a long-term approach to DSM is needed.
- Enbridge should develop DSM programs that encourage broader awareness about energy efficiency and encourage behavioral change.
- Enbridge is a trusted and well-respected organization that can build local capacity through training and educating customers and contractors.
- The current budget for incentives and energy efficiency solutions is not enough. Increased incentives are needed to encourage customers to purchase more expensive equipment.
- Most small commercial businesses rent their properties. This makes it difficult to get them to think long-term about things like carbon reduction and GHG emissions.

DSM Planning – 2012 and beyond

Customer Needs

- Small businesses/commercial operators don't have the time or skills to calculate energy savings as a result of a new technology or efficiency strategy. Enbridge should assist small commercial customers in conducting energy modelling, energy savings calculations so they can see verifiable savings.
- Currently there is no benchmarking or standardization of energy efficiency equipment in Ontario. Enbridge should act as a third-party that provides quality assurance and testing of new equipment.
- Enbridge representatives have helped customers fill out the incentive paper work/applications in the past. This service is extremely valuable for managers/contractors that are too busy to add another task to their existing workloads.
- Contractors do not have the time to calculate energy savings for their customers. Enbridge should work with commercial customers to outline the cost savings that can be expected from adopting new technologies or operating practices.

New DSM Initiatives

Customer Support Initiatives

- Enbridge could help small businesses by testing new equipment and providing quality assurance to help encourage the adoption of new technologies and energy efficiency strategies.
- Energy efficiency tradeshows or forums would be an effective way to educate contractors about the technologies and incentives available to Enbridge customers.
- Building owners and operators are responsible for long-term operations and maintenance of small commercial facilities. Enbridge should direct their resources to target these people rather than tenants of commercial properties.
- It would be valuable for Enbridge to develop a database/web portal of best practices and case studies of program success to encourage further changes in the commercial market.
- Providing technical advisors to local BIAs to discuss energy efficiency with local business would be an effective way to target local commercial businesses.
- Enbridge should explore the viability of doing community-wide retrofitting programs where cost savings can be achieved through bulk purchasing and installation.
- Providing interest free loans to customers might be a way to reduce the payback period for new technologies and equipment. Enbridge should explore the use of on-bill financing for purchasing new energy efficient equipment.
- Enbridge should explore the viability of having small commercial properties use residential condensing units to heat their buildings.
- Incentives should cover the difference in cost between low and high efficient technologies.
- Providing small commercial customers with access to a roving energy auditor/energy solution consultant would be a cost effective way to educate customers. The auditor/consultant could visit customers on site and provide customers with a number of recommendations and information about programs offered by Enbridge.
- Creating an online energy consumption/assessment tool would be a cost effective way to educate consumers and provide preliminary auditing information.
- Enbridge should explore the option of having commercial customers voluntarily segment themselves into market categories so they can receive tailored energy efficiency information and tips available to them from Enbridge.
- The current budget for incentives and energy efficiency solutions is not enough. More money is needed to provide meaningful subsidies/incentives to customers.

Carbon Footprint and Emission Reduction Programs

- Carbon footprint reduction is on the mind of larger companies and major retailers. However, they are more interested in carbon reduction as part of an overall corporate social/environmental responsibility strategy.
- Companies are aware of the need to reduce their carbon footprint, however until there is a price for carbon, businesses are unlikely to spend money on emission reduction strategies.
- Ways to integrate carbon footprint reduction strategies into designs of buildings are available, but they are often overlooked due to cost.
- Carbon footprint reduction is included in construction tenders and RFPs; however it is often tokenistic and "green washing."

- Small commercial businesses look at short payback periods for investing in new technologies or programs. Most small businesses are focused on survival rather than carbon footprint strategies.
- Most small commercial businesses rent their properties. This makes it difficult to get them to think long-term about things like carbon reduction and GHG emissions.
- Tenants and landlords often fight over energy efficiency and energy costs. Often times, building tenants pay the energy bill while the landlord pays for the installation and maintenance of building equipment.

Renewable Energy

- Commercial operators would be more interested in wind and solar energy projects if the return on investment was improved through incentive programs.
- The payback period for renewable technologies is too long.
- Large commercial retailers are only interested in renewable energy for pilot projects or 'flagship' stores.

Promotion of Energy Efficiency

- Enbridge should work to encourage changes to the building codes for commercial properties.
- There should be one agency in Ontario that is responsible for energy efficiency grants and rebates.
- Enbridge should look at developing a sector specific marketing campaign and a website to ensure customers have easy access to information.
- Small businesses are more likely to read material from trade associations and other consumer associations than they would be from Enbridge (e.g. ORAC, EECN).
- Forums/conferences (e.g. Enterprise Toronto) where businesses can talk to businesses about best practices would be an effective way to educate consumers.
- Enbridge should introduce commercial businesses to new technologies, incentives, and programs through the various trade associations (e.g. HRAL, BOMA, BILD).

Capacity Building and Training

- Enbridge should develop training programs for contractors, property managers, and building operators to educate them about the programs and incentives available through Enbridge and best practices for energy efficiency.
- Building owners and operators need to be educated about how to properly commission, monitor, and maintain new technologies once they are installed.
- Enbridge is a trusted organization that can provide training and education to customers and contractors.
- Enbridge should host control training sessions for building operators.

Partnership Building

- Contractors often have a good relationship with end users and could be a valuable gateway into the commercial market.
- Enbridge should collaborate with other energy utilities to ensure there is unified energy efficiency messaging.
- Enbridge should partner with the City of Toronto on their new Green Card Program offered to local retailers. The Green Card is a way to incent small businesses that are 'green' by providing them with marketing assistance if they meeting certain energy and water efficiency standards.

- Attending contractor association meetings, providing sales training, and hosting trade shows/forums would be an effective way to educate consumers about new technologies, case studies of success, and encourage industry benchmarking. These events should be conducted in cooperation with hydro utilities.

Comments on Existing DSM Programs

- The marketplace takes a long time to recognize the value of new technologies.
- It is ineffective to provide a $100 incentive to commercial building owners for a rooftop heating system that would likely cost $10,000.
- Incentives need to be tagged to efficiency levels rather than specific technologies.
- Incentives should be targeted to contractors. They are the ones that do the bulk of the work to seek out new technologies and fill out the necessary paper work.
- Different approaches are needed to target national retail account holders and independent businesses.
- Enbridge should explore the option of developing an energy auditing program in collaboration with LDCs (hydro) and local municipalities (water).
- Condensing air conditioning units and infrared programs should be prioritized over rooftop heating systems until manufacturers improve their products.
- Seasonal incentives are not effective as they can create confusion during busy periods. Reliable/constant incentives are preferred over seasonal rates/offers.

5 Commercial Sector

The following section provides a summary of the comments received from workshop participants during the commercial sector workshop. A more detailed account of the comments received can be found in Appendix D.

Key Priorities for Commercial Clients

- Establish a benchmarking/monitoring program which includes third-party auditing.
- Create a certification program for building operators and property managers.
- Enbridge is a consistent and trustworthy organization. They should lead training initiatives that help contractors take a systems approach to energy management.
- There is a need for data driven decision-making. Enbridge should assist commercial customers in collecting and analyzing real-time gas consumption data.
- An integrated, one-window customer service portal for energy efficiency programs in Ontario should be created.
- Roundtable discussions, symposiums, conferences, and forums to discuss best practices would be an effective way to encourage greater cultural change in this sector.

Comments on the Proposed Strategy

- DSM programs need to move beyond incenting new technologies. Building commissioning is pivotal for effective energy management and achieving long-term savings.
- Most commercial customers lack the capacity to monitor and analyze building performance. Enbridge should offer technical support and training programs to empower their customers to implement energy efficiency strategies.
- It is important for Enbridge programs to remain consistent so that operators will know that the program will be available in the future.
- Training/education and incentives are key components to successful DSM. Incentives provide direct cause and effect relationship while training increases social capital and organizational capacity.
- There is a tremendous need for monitoring equipment and real-time data collection in the industry to find deep savings. Real-time monitoring in the school system has created a culture of conservation amongst staff members and students.

DSM Planning – 2012 and beyond

Customer Needs

- Proper building commissioning is largely overlooked in the industry. It is vital that building designs are tested to see if total building performance is meeting the design standards/guidelines.
- Commercial customers need assistance with monitoring building performance. Not all customers can afford to hire energy engineers to conduct analysis and monitoring programs.
- Enbridge provides a superior level of customer support in helping people find opportunities to make their building more efficient.
- Large commercial clients need a full-time staff member to fill out applications and paper work for incentives. Enbridge should provide further assistance to customers wanting to take advantage of their programs.

- Enbridge should provide assistance to clients preparing RFPs so they can integrate incentives and programs into their bidding processes.

New DSM Initiatives

Customer Support Initiatives

- Incenting energy auditing and monitoring programs would be a useful way to encourage a system approach to building operations and maintenance.
- Enbridge could play an important role in providing clarity surrounding energy monitoring and accountability through acting as a third-party auditor.
- Real-time data collection for natural gas is an essential component of effective energy management. Enbridge offers customers technical support collecting and analyzing data as well as subsidies for purchasing gas meters. This will enable data driven decision-making and further energy savings for customers.
- Developing boilerplate, preapproved designs for energy management systems in buildings would be a useful way of ensuring energy efficiency is included in the design of new buildings.
- Real-time monitoring in schools has created a culture of conservation amongst staff members and students.
- Enbridge should encourage benchmarking through assisting commercial clients in conducting building performance audits. The information should be put into a database, synthesized, and shared with other commercial clients.
- Enbridge programs need to remain consistent so that operators will know that programs will be available in the future.
- Incentives should be given in stages and tagged to actions. As an example, small auditing grants could be given for conducting a feasibility study for a new product or technology. Once implemented, a larger grant could be provided for long term monitoring and assessment.
- Re-commissioning and ongoing building performance programs are needed to ensure building performance is maintained. Often changes are made to energy management systems after buildings have been commissioned.
- Enbridge should develop a list of consultants that could assist building owners and operators in the event that Enbridge cannot provide them with technical expertise/assistance.
- Incentive caps for larger projects should be removed. There should be deeper incentives for deeper savings.
- Training/education projects and incentives are both key components to successful DSM. Incentives provide a direct cause and effect relationship while training increases social capital and organizational capacity.
- The formation of a web portal would be an effective way for commercial customers to understand what incentives are programs are available to them.
- Online tracking of the incentive/grant approval process for incentives and grants would be a valuable resource for Enbridge customers.
- Coordinating with suppliers to provide coupons for energy efficiency products would a streamlined and effective way to provide subsidies/incentives to customers.
- Giving incentives to contractors would be practical way to ensure energy efficient products get marketed to customers.
- Often money received from Enbridge incentives/grants gets sent back to finance departments where money is put back

into general revenue, rather than used to offset the costs of new products/technology. It would be more effective for rebates to come off the gas bill.
- Providing smaller commercial customers with basic/simple energy audits could be an effective way to increase understanding about energy efficiency.
- Highlighting best practices and case studies through factsheets would encourage benchmarking in the industry and create competition to save energy.
- Enbridge should explore the viability of having awards for building performance. (e.g. "Building Operator of the Year")
- Roundtable discussions, symposiums, conferences, and forums to discuss best practices would be a great way to get people excited about energy efficiency.
- Providing an anonymous benchmarking database for customers would be an effective way to see how one's building performance measured up to others in the industry.

Carbon Footprint and Emission Reduction Programs
- Carbon footprint measurement is important to many large commercial customers. They have established GHG targets for the next five years and are actively measuring/monitoring building performance.
- Although GHG emissions are important, it is not a decision-making factor for large projects at this point in time. Financial payback and operating costs are the drivers for energy efficiency; carbon reduction is a secondary benefit.
- Tenants of large commercial properties are beginning to establish corporate goals and emission reduction targets that are having an impact on building owners.
- Measuring carbon emissions is a difficult endeavor with a tremendous amount of variability. Total building performance and energy savings should take priority over carbon emission counting.
- Carbon reduction will not be a decision-making factor until there is a set price for carbon.
- There is increased recognition that incorporating sustainability into building operations is part of good business practice.

Renewable Energy
- Distributed energy would be attractive to the commercial sector if it adds value to assets upon sale. Generally, such projects have been a risky venture for asset managers.
- Biogas generation is not a viable option for commercial customers. It is more of an opportunity for municipalities and utilities.
- The most viable renewable technology for commercial customers is solar thermal heating systems. Generally, without incentives the business case for renewable technologies is weak.
- Enbridge should not undermine DSM by undertaking renewable energy projects.

Promotion of Energy Efficiency
- Industry benchmarking would be an effective way to highlight early adopters and energy champions. This could help spur overall market transformation.
- Energy utilities should collaborate to ensure their programs are achieving a common goal.
- Energy efficiency messaging should be integrated across all utilities. One-window customer service portals (telephone lines and websites) should be developed.

Capacity Building and Training

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Exhibit B
Tab 2
Schedule 8

- Enbridge is a consistent and trustworthy organization. They should lead training initiatives that help contractors take a systems approach to energy management.
- Building commissioning is a pivotal component of energy management. Enbridge should train building operators how to properly commission buildings.
- Training programs need to be hands-on and include training at their specific facility rather than hosting a series of theoretical lectures about energy efficiency.
- Establishing a certification program for building operators would be an effective way to build capacity, bring professionalism into the industry, and encourage capacity building.
- Enbridge is the expert on gas technology. Educational programs should be developed to transfer that expertise to building owners and operators.
- More education is needed to show building operators how to properly maintain equipment, read boiler combustion reports, and restaurant ventilation.

Partnership Building

- Increased collaboration is needed. It is difficult for customers to determine which programs or incentives are available to them.

Comments on Existing DSM Programs

- Institutional sectors have longer payback criteria and should be targeted differently than private operations.
- Enbridge's planning horizon follows a different timeline than most companies' fiscal year-end. This makes it difficult to capitalize on Enbridge incentives and programs as representatives generally wait approach customers at their year-end.
- It is important to have an integrated approach to energy management. The objectives and financial resources that gas and electric utilities have to run their programs should be standardized.

6 Residential Existing Homes Sector

The following section provides a summary of the comments received from workshop participants during the residential existing homes workshop. A more detailed account of the comments received can be found in Appendix E.

Key Priorities for the Residential Existing Homes Sector

- There needs to be a systems approach to energy efficiency. Currently, the focus is on individual technologies rather than overall building envelope performance.
- True collaboration amongst LDCs and gas utilities is needed to ensure they are working towards a common energy efficiency goal.
- Ensuring customers understand the payback period, cost savings, and monthly cash flow is crucial for the adoption of energy efficiency programs.
- Energy efficiency training and accreditation for contractors, renovators, energy auditors, and realtors is needed to encourage professionalism in the industry and an understanding of energy management for residential dwellings.
- There is a tremendous amount of misinformation in the sector. As a respected leader in energy efficiency, Enbridge should simplify existing messaging and ensure it reaches a broad array of audiences (e.g. realtors, trade associations, community groups, new home owners, etc.)

Comments on the Proposed Strategy

- Enbridge should work with local energy utilities to establish cultural norms/social expectations for energy efficiency adoption in the residential market.
- A longer-term approach to DSM is needed if behavioral/cultural change is to be achieved.
- Most homeowners do not understand how energy efficiency relates to building performance/cost. Establishing an integrated energy auditing program would be an effective way to educate consumers, find deeper energy savings, and encourage cultural change.
- Collaboration amongst all energy providers is needed to educate and build organizational capacity for energy efficiency.
- Enbridge should continue to take a bottom-up approach and work with their stakeholders to find practical solutions that make sense in the field (i.e. energy auditing programs, training, etc.). This will build social capital and empower stakeholders to take energy efficiency on as their own personal mission.
- The Ontario Energy Board has been predominately focused on short-term and quick results. A long-term approach to educate consumers about energy efficiency is needed in order for Enbridge to be successful.

DSM Planning – 2012 and beyond

Customer Needs

- Enbridge provides superior levels of support and technical expertise to its customers on how to adopt and maintain energy efficiency practices.

- There is a tremendous amount of inaccurate information in the sector. Enbridge and other utilities can play a valuable role by providing third-party information to residential customers.
- An integrated approach to energy efficiency is needed. Competing gas and electric programs are creating confusion in the marketplace.
- Residential customers need to be educated about the energy costs associated with not upgrading existing housing stock.

New DSM Initiatives

Customer Support Initiatives

- Enbridge should consider the viability of assisting customers in calculating their carbon footprint
- Ensuring should help customers calculate payback periods, cost savings, and determine monthly cash flow when purchasing new equipment.
- Enbridge should explore financing programs for purchasing energy efficient technologies (e.g. on-bill and property tax financing) that is available to all residential customers, including low income households.
- Enbridge should explore hosting community-wide retrofit projects as part of a greater initiative that encourages cultural/behavioural change. Community retrofit projects can achieve up to 50% savings for the individual homeowner due to economies of scale and as a result often elicit extremely high participation rates.
- Generic case studies would be a valuable tool for educating customers on how much they will save on their energy bill by adopting energy efficiency technologies/products.
- Online calculators and factsheets are relatively easy ways to educate residential customers about energy efficiency.
- There are still a number of "quick wins" in the residential existing homes sector (e.g. weatherization).
- A simplified and fully integrative labeling system (e.g. gas, hydro, and water) is needed.
- Energy efficiency offices would be a useful way to educate local communities and help home owners address any concerns or questions that they might have.
- Tax rebates have been an effective way to incent energy efficiency in the United States.
- Leading pilot projects to prove cost effective measures and technology performance would be an effective way for Enbridge to highlight new technologies and products.
- There should be more incentives to encourage low income households to move away from electric space and water heating. This is a program that could be delivered in tandem by local LDCs and Enbridge.
- Enbridge should target energy efficiency products and incentives to people who are purchasing homes (e.g. Welcome Wagon, address change kit, SmartMoves). Studies have shown that homeowners are likely to make improvements within the first 2-3 years. Municipalities would be an effective partner for such projects.
- There is a real need to disseminate success stories and case studies to stakeholders to encourage them to consider alternative patterns of behavior.
- An energy auditing program would be an effective way to educate consumers and obtain data to validate Enbridge projects and decision made by homeowners.
- Enbridge should create a program that encourages homeowners to conduct basic maintenance on their heating systems. This is an unexplored area that needs further investigation.

- Create a performance based green realtor program that would give realtors a green badge for selling energy efficient homes.

Carbon Footprint and Emission Reduction Programs

- Most customers understand the need for carbon footprint reduction. However, it is generally seen as an added bonus for achieving energy savings.
- In general, residential customers do not understand the relationship between energy savings and GHG emission reductions. Enbridge could play an important role in explaining this relationship to its customers.

Renewable Energy

- There is interest in co-generation but often times the people managing project finances do not want to pay upfront costs for large scale projects.
- Enbridge should place priority on reducing overall energy consumption, rather than finding renewable energy sources.

Promotion of Energy Efficiency

- There is a tremendous amount of misinformation within the sector. Enbridge can play a valuable role by providing third-party information to residential customers.
- Enbridge should lobby the government to make energy audits mandatory when selling a home. This would be an effective way to increase awareness about energy efficiency.
- Enbridge should work with regulatory bodies to increase building code standards and encourage the development of simplified energy labeling systems.
- Enbridge should partner with and support trade/contractor associations to encourage the adoption of best practices and new technologies in the energy sector.
- Enbridge should act as a consistent voice for energy efficiency and lobby the government to establish long-term, consistent energy efficiency programs and policies.
- Enbridge should develop consistent and regular messaging to contractor associations and other professional networks (e.g. HRHI, EECN, ORAC, real-estate boards) so they understand what energy efficiency solutions are available to homeowners.

Capacity Building and Training

- Establishing training programs for contractors would encourage greater accountability within the industry.
- Residential customers need to be educated about the energy costs associated with not upgrading existing housing stock.
- Further training for contractors and technicians is needed. Many homeowners are currently being sold equipment that impractical for their homes due to lack of education/awareness.
- More training is needed for gas technicians so they can understand building energy dynamics for their clientele and act as energy solutions consultants.
- It is important for both contractors and homeowner to understand energy measurement tools.
- There is a considerable need to professionalize the energy efficiency industry. Enbridge should invest time and money into training programs, accreditation, etc. that build capacity and social capital. Providing a list of qualified contractors would also bring legitimacy to the industry.
- Homeowners are susceptible to being taken advantage of by contractors. Information for homeowners is needed to ensure they can make appropriate decisions about heating system sizing, furnace types etc.

- Enbridge should act as advisors in apprenticeship programs to ensure program curriculum addresses market conditions.

Partnership Building

- Municipalities, NGOs, and other local community groups are key partners for implementing new programs in communities.
- There needs to be true collaboration amongst LDCs and gas utilities to ensure they are working towards one common goal rather than piecemeal objectives that can be contradictory.
- There needs to be a systems approach to energy efficiency. Currently, the focus is on individual technologies rather than the entire building. Gas and electricity utilities need to work together to develop an integrated approach.
- Similar to the adoption of blue box recycling programs, Enbridge should work with local energy utilities to establish cultural norms/social expectation for energy efficiency.
- Information about energy efficiency needs to be simplified and come from one standard source. Homeowners want to speak to one person about energy efficiency rather than separate representatives from gas, hydro, and water utilities.
- Enbridge should examine the opportunity to partner with other key organizations that have a strong local presence (e.g. universities, colleges, public schools).
- Enbridge is a logical leader of energy efficiency programs in Ontario. They have been in the industry the longest and have the respect of homeowners across the Province.

Comments on Existing DSM Programs

- Incentives can be counter intuitive as residential customers can often be taken advantage of by contractors by overcharging for installation.
- Incenting one particular product for a short period of time can also act as a long-term disincentive as people are often unwilling to pay for a product that was once free.
- Incentive programs and subsidies need to make sense in the field. Currently, there is a disconnect between ideological solutions and practical solutions that exist in the field.

7 Large New Construction Sector

The following section provides a summary of the comments received from workshop participants during the large new construction sector workshop. A more detailed account of the comments received can be found in Appendix F.

Key Priorities for the Large New Construction Sector

- Customers need to be made aware of Enbridge programs during the design/planning stages so incentives, grants, and gas efficiency strategies can be incorporated into the construction planning.
- There is a great need for monitoring and verification of building performance. Enbridge should develop a monitoring/auditing program to encourage industry benchmarking.
- Incentives for energy modelling would be a practical way to ensure energy efficiency is integrated into building designs.
- Establishing a one-window web portal or hotline for energy efficiency would be a valuable tool for building designers.
- Enbridge should work with the OPA and LDCs to combine/integrate their programs so there is a unified voice for energy efficiency.
- Enbridge should showcase and endorse success stories, leadership, and innovative design undertaken by clients on their website, marketing in materials, and at industry social events. Recognition will inevitably lead to market transformation.

Comments on the Proposed Strategy

- Incenting specific technologies has been largely ineffective. A longer term approach that focuses on building design and performance is needed.
- Retrofitting existing buildings offers the greatest opportunity for deep energy savings.
- There is a need to build capacity amongst building owners and operators so they can understand the cost of using inefficient technologies and operations practices.
- Building capacity through training, education, and awareness is an effective way to encourage cultural and organizational change.

DSM Planning – 2012 and beyond

Customer Needs

- Customers need to be made aware of Enbridge programs early in the design process so programs and incentives can be integrated into building design.
- Enbridge should continue to offer administrative support to fill out applications for grants/incentives.
- Designers need assistance developing the business case for energy efficiency.
- Monitoring and validation programs are needed to ensure buildings are performing optimally.

New DSM Initiatives

Customer Support Initiatives

- Funding for gas and electric incentives should operate on a level playing field.
- Enbridge should work with LDCs and the OPA to deliver holistic programs and incentives that focus on total building performance.

- Educational campaigns are effective ways to encourage market transformation. If consumers are educated they will demand changes to the system.
- Enbridge should provide municipalities with assistance in preparing energy efficiency bylaws (e.g. Toronto Green Standard).
- New programs should focus on building commissioning.
- Enbridge should supply third-party commissioning agents to ensure buildings are performing efficiently. This would also create transparency and accountability in the industry.
- Enbridge should inform customers that they offer program and applications support.
- Enbridge should create a benchmarking database to foster greater awareness and competition.
- Conferences/symposiums and case studies of success stories on the Enbridge website would recognize leadership in the industry and showcase best practices.
- Enbridge should develop a hotline /web portal for building modellers and designers so they can easily access Enbridge programs.
- There is a great need to brand integrated energy efficiency. Currently, programs like LEED and ASHRAE do an inadequate job encouraging improvement to total building performance.
- A one-window portal for energy efficiency that combines OPA and Enbridge programs would be extremely valuable to engineers and project managers.
- Subsidies to complete energy modelling would be an effective way to build the business case for energy efficiency.
- Showcasing best practices, case studies and new technologies on the Enbridge website would be a practical way to educate customers.

Carbon Footprint and Emission Reduction Programs

- Unless forced to through regulations (e.g. municipal bylaws), most businesses will not integrate emission/carbon reduction into their operations.
- GHG reduction will not be a priority for the majority of businesses until there is a fixed price for carbon.
- Carbon footprint reduction and GHG reduction are secondary benefits to cost savings achieved through energy efficiency.
- In general, businesses do not understand the basics of carbon footprint analysis.
- Municipal bylaws are creating some interest in carbon footprints and emission reduction (e.g. Toronto Green Standard).

Renewable Energy

- Larger institutions and facilities are interested in the potential for co-generation.
- Businesses are hesitant to explore the viability of district energy solutions and are worried about associated risks.
- Large facilities are interested in energy self-sufficiency and security.

Promotion of Energy Efficiency

- Enbridge should lobby the Provincial government for further reform to the Ontario Building Code.
- Benchmarking, through programs like LEED, is a valuable way to promote energy efficiency in the industry.
- Enbridge should target trade and professional associations for energy efficiency messaging to ensure it reaches the right audience (e.g. PMP network, OAA).

- Enbridge should advertise that they have representatives to help customers with energy efficiency strategies.
- Educating condo owners about energy efficiency could be an effective way to encourage condo builders to change their practices.
- Enbridge should target universities to promote awareness of energy efficiency amongst students, staff, and facilities staff.

Capacity Building and Training

- Training programs are needed to educate building owners and operators about how to calculate operating costs and understand the impacts of inefficient operating practices.
- Enbridge should offer seminars to LEED professionals to make them aware of Enbridge programs.
- There is a need to train architects and designers on how to design more efficient buildings using current software packages.

Partnership Building

- Enbridge should work with other utilities to create a common voice for energy efficiency.
- Incentives and grants for energy efficiency need to be integrated across all utilities.

Comments on Existing DSM Programs

- Existing incentives are too low to encourage meaningful change in the sector.
- Enbridge should work with the OPA and LDCs to combine/integrate their programs so there is a unified voice for energy efficiency.
- Strategies and incentives for control systems should accompany programs for the installation of high efficiency boilers.

8 Residential New Construction Sector

The following section provides a summary of the comments received from workshop participants during the residential new construction sector workshop. A more detailed account of the comments received can be found in Appendix G.

Key Priorities for the Residential New Construction Sector

- Communication lines between homeowners, builders, and suppliers need to be improved to ensure information is reaching end users and enablers of energy efficiency.
- It is important to showcase industry leaders and early adopters of energy efficiency to improve awareness and encourage broader cultural change.
- Disseminating messages through channel partners (e.g. trade associations) is an effective way to encourage organizational change and industry benchmarking.
- A one-window approach to energy efficiency is needed to ensure people aren't confused by approaches that are underway from gas utilities and local LDCs
- There should be increased focus on training builders, tradespersons, sales representatives, and homeowners to increase awareness about the benefits of energy efficiency and capacity to help customers implement new strategies and actions.
- Messaging needs to be simplified to focus on cost savings resulting from energy efficient technologies and practices.

Comments on the Proposed Strategy

- Enbridge's long-term strategy is appropriately focused on long-term objectives and strategies to drive energy efficiency. The Ontario Energy Board will need to adjust their expectations in order for Enbridge to be successful in the future.
- Existing incentives to purchase new technology are too low and discourage innovation. Enbridge should focus their resources on building social capital and encouraging cultural changes.
- Enbridge and the Province need to understand that it takes a long time for people see the effects of social marketing. There needs to be a shift in how consumers are approached. To date, products have been used to encourage energy efficiency. Looking ahead, behavioural change is needed to achieve success. This will take significantly longer and cost more than previous programs offered by Enbridge.
- Continuing to subsidize new technologies will create chaos and confusion in the marketplace. Focus should be on building capacity and social capital to instigate change not incenting specific technologies or products.
- Enbridge needs more money from the OEB to properly develop programs that will have long lasting changes.

DSM Planning – 2012 and beyond

Customer Needs

- There is a lack of monitoring and proper building commissioning to ensure energy efficiency initiatives achieve long lasting results.
- Research on the effectiveness and actual building performance of new technologies is desperately needed in the industry.

Filed: 2011-11-04
EB-2011-0295
Exhibit B
Tab 2
Schedule 8

New DSM Initiatives

Customer Support Initiatives

- It is important to showcase industry leaders and early adopters.
- Existing incentives to purchase new technology are too low and discourage innovation. Enbridge should focus their resources on building social capital.
- Many builders and homeowners do not understand existing home energy rating systems (e.g. EnerGuide and Energy Star). A simple, universally adopted rating system should be developed.
- Enbridge should work with local LDCs to create an integrated, one-window energy efficiency program that is accessible and easy to navigate.
- Currently, the average consumer pays more on their cell phone bill than on heating costs. Cost savings should be a driving message for DSM programs.
- Enbridge and the Province need to understand that it takes a long time for people see the effects of social marketing. There needs to be a shift in how consumers are approached. To date, products have been used to encourage energy efficiency. In the future, behavioral changes will be needed to achieve success. This will take significantly longer and cost more than previous programs offered by Enbridge.
- It is important to get accurate and reliable information to customers. Enbridge can play an important role in hosting this information on their website as they are regarded as a credible and trusted source of knowledge.
- Enbridge should provide training to salespersons so they can parlay information about energy efficiency to home buyers. To encourage participation at training, Enbridge should go to monthly sales meetings for different builders or offer a stipend to attend training on behalf of their organization.
- Enbridge should highlight builders who are adopting best practices to try and encourage benchmarking in the industry.
- Contractors who currently build to Energy Star ratings are not marketing their homes as energy efficient. Enbridge should reward new home builders who build to higher energy efficiency standards.
- Highlighting case studies of best practices in the industry would increase awareness about energy efficiency, foster competition amongst builders, and help spur market transformation as consumers demand for more efficient homes.
- Enbridge should work with financial institutions to create opportunities for home buyers to finance energy efficiency programs through their mortgage payments. Alternatively, banks could offer a 1-2% savings off their home if a person chooses to purchase an energy efficient home.
- An incentive program for sales representatives who sell energy efficient housing should be created. Representatives can "score" points for each home that is sold after they reach the threshold of homes sold. They could market themselves as an "Enbridge Certified Green Sales Representative."
- Enbridge should explore the opportunity to give home buyers who purchase Energy Star homes a green gift to purchase energy efficient appliances and other products.
- In a slowing housing market, builders are primarily concerned about profitability and mitigating risk. DSM programs need to target one of these two points to be successful.
- Subsides for new technologies create chaos and confusion in the market. Focus should be on building capacity and social

capital to instigate change not incenting specific technologies or products.
- Creating a discovery home/site where people can go see an energy efficient home is an effective way to educate builders, contractors, and home buyers.
- Trade councils are effective ways to engage tradespersons in energy efficiency conversations.
- In the end, technologies will drive market transformation. Enbridge's role should be to provide end users and enablers with accurate, reliable, and neutral information about energy efficiency products and technologies.
- Enbridge should help debug and test new technologies for builders so builders and contractors know what products are effective in the marketplace.
- Enbridge should focus resources on major builders and industry leaders to encourage market transformation rather than offer small incentives to every contractor.
- Conferences, symposiums, and networking sessions for sales representatives, builders, and contractors would be a great way to market Enbridge programs and services.
- Rather than give $100 dollars to every builder, Enbridge should provide training services to select organizations and pay for their entire sales teams to attending training. Alternatively, they could provide individuals builders or salespersons with $1000 to attend a green building seminar.

Carbon Footprint and Emission Reduction Programs
- Carbon footprint reduction and climate change is too abstract of a concept for the average homeowner and builder.
- Messaging should steer away from altruistic motivations such as climate change and encourage the adoption of energy efficiency practices to reduce operating costs.

Renewable Energy
- Of the renewable energy technologies out there, solar thermal heating systems are likely the most realistic for new home construction.
- Most builders are not interested in district energy opportunities because it is not financially viable.

Promotion of Energy Efficiency
- Enbridge needs to communicate successes in the industry. Between 1997 and 2010 there has been a 40 percent reduction in housing energy use.
- Communication lines between homeowners, builders, and suppliers need to be improved to ensure information is reaching end users and enablers of energy efficiency.
- Enbridge should work to encourage continued changes to the Ontario Building Code.
- Enbridge should lead a marketing campaign of builders who are adopting energy efficient building practices.
- New home buyer seminars could be a way to increase awareness about energy efficiency and what they should look for and ask builders when purchasing for a new home.

Capacity Building and Training
- There is a need to provide sales training to ensure customers are receiving adequate information about energy efficiency products in new homes.
- There is a general need to increased training for builders, tradespersons, and homeowners to increase awareness.
- The average consumer does not understand how homes are heated and what energy sources they are using. People only know that their furnace is either working or it isn't.

Partnership Building

- Existing energy efficiency initiatives are being implemented in isolation. There needs to be a coordinated effort amongst utilities to ensure the message is not being lost.
- Enbridge should collaborate with trade associations to better market their programs and services.
- All of the major players in hydro and gas energy efficiency should work together to develop a coordinated strategy to market energy efficiency, a simple rating system for new home construction, and continued lobbying for build code reform in Ontario.
- Municipal governments (councilors, regional planners, etc.) need to be educated about holistic planning approaches for energy efficiency.

Comments on Existing DSM Programs

- Enbridge should recognize that the building industry is focused on profit margins, cost savings, and risk management. These are the driving decision-making factors for energy efficiency initiatives.
- The average homeowner will live in a house for 3-5 years. Enbridge messaging should reflect this reality.
- There are structural barriers for encouraging tradespersons to adopt new technologies and change their current practices (e.g. unionized workers, changes to apprenticeship programs, etc.). As a result, DSM programs should not be tailored to tradespersons.
- Providing builders with free/subsidized products to install in homes are likely unsuccessful because it adds risk to the construction process by adding in more tasks for tradespersons.
- Previous attempts to subsidize individual technologies have resulted in contactors escalating their service pricing and fees.

9 Municipal Sector

The following section provides a summary of the comments received from workshop participants during the municipal sector workshop. A more detailed account of the comments received can be found in Appendix H.

Key Priorities for the Municipal Sector

- Municipalities need assistance monitoring gas consumption and benchmarking the performance of their facilities against other institutions.
- Providing municipalities with technical support to analyze consumption data and conducting energy mapping exercises would be beneficial to rural municipalities that lack organization capacity.
- Enbridge should collaborate with municipal energy offices to ensure gas reduction programs are integrated into municipal projects and plans.
- A one-window, single point of contact for energy efficiency is needed to ensure messages from different utilities are not lost.
- Neighbourhood blitzes and community-wide retrofit projects are effective ways to educate the public and encourage cultural change. Municipalities are natural partners for Enbridge on these types of projects.

Comments on the Proposed Strategy

- A long term approach to energy efficiency is needed. In order for projects to be successful, all players need to commit to a project for the long-term and see it through to completion.
- Many municipalities lack the capacity to monitor energy consumption in detail. Building capacity through training programs for municipal building operators would be an effective way to increase awareness about new technologies and efficiency strategies so long lasting savings can be achieved.

DSM Planning – 2012 and beyond

Customer Needs

- Enbridge could be a valuable resource to municipalities by providing them with data that could be used in carbon footprint analysis.
- Enbridge should collaborate with municipal energy offices to ensure gas reduction programs are integrated into municipal projects and plans.
- Currently, extensive monitoring is taking place for electricity and little is being done for gas. Enbridge should work to enable municipalities to track gas consumption patterns.
- Enbridge should assist municipalities in benchmarking their buildings against each other.
- Many municipalities lack the capacity to undertake integrated energy management. Enbridge can provide valuable expertise in guiding their planning processes.
- Municipalities need assistance monitoring gas consumption at their facilities. Of the 444 municipalities in Ontario only a handful have Energy Conservation Officers.
- Smaller municipalities need help collecting, organizing, and synthesizing gas consumption data.

- Proper building commissioning is a crucial part of sound energy management. However, municipalities need long term support to ensure monitoring and verification of building performance takes place.

New DSM Initiatives

Customer Support Initiatives

- Many smaller municipalities lack capacity to undertake detailed research projects. Providing municipalities with technical support to analyze consumption data and conducting energy mapping exercises would be extremely beneficial.
- Enbridge should subsidize the purchase and installation of pulse meters so that municipalities can begin to understand consumption patterns and monitoring real-time gas consumption.
- It is important for Enbridge to take a two pronged approach with municipalities. They should target municipalities at a strategic level (e.g.) councillors, CAOs, planners) and at a practical level through facilities management personnel (e.g. building operators, recreation facilities managers).
- A designated municipal contact/liaison officer would be a valuable resource for municipalities to gain information about Enbridge programs.
- Enbridge should educate municipalities about their programs and incentives.
- A database of available incentives and grants in Ontario would be useful for municipalities.
- Analyzing consumption patterns in communities can be beneficial to both municipalities and Enbridge as they can see where they should target energy efficiency initiatives (e.g. housing stock from the 1960s).
- A one-window, single point of contact for energy efficiency is needed to ensure messages from different utilities are not lost and residents understand the need to reduce energy consumption.
- Building permit and approval processes could be leveraged to fast track green buildings and energy efficient renovations.
- For many small municipalities, accounts payable pay the gas bills. As a result, municipalities are often not collecting, analyzing, or monitoring gas consumption patterns.
- Standardized, "Plug and Play" software platforms, similar to that of tax software systems, could be an easy way to increase municipal capacity for energy management.
- There are real opportunities for Enbridge to work with municipalities to improve the operations of the facilities (e.g. municipal head offices, arenas, recreational centres, pools, etc.)
- Educational campaigns and community-wide retrofit projects are practical ways to teach people about home energy use, encourage the adoption of efficient technologies, and spur cultural changes in communities.
- There is an opportunity to integrate energy efficiency into land use planning, community improvement plans, secondary plans. Enbridge should work with municipalities to build capacity to address energy into municipal planning strategies.

Carbon Footprint and Emission Reduction Programs

- Although GHG reduction may not be a top priority for municipalities at this time given the current economic and political climate, it is still a decision-making factor.
- Some municipalities have completed greenhouse gas inventories for municipal operations that focus on emission reductions.

- Enbridge can assist municipalities in developing both short- and long-term actions that could be used to meet green house gas reduction targets.

Renewable Energy

- Municipalities need assistance in understanding how district energy would work in their communities.
- Enbridge should be involved in ownership models and business arrangements for distributed and district energy solutions at the municipal level.
- Over time, more municipalities will initiate green bin programs. This is a great opportunity for Enbridge to tap into waste reduction strategies of municipalities for biogas production.
- Distributed and district energy projects need to prioritize local job creation.
- On bill financing for solar water heating would be a useful way of replace federal government funding.
- Enbridge should work with municipalities to understand how they can convert organic waste (e.g. food waste, urban forestry waste, etc.) to municipal gas.
- Municipalities are keenly interested in biogas projects. "If you produce waste here you should deal with it here."

Promotion of Energy Efficiency

- Municipalities recognize the important of energy/sustainability rating systems and are working toward integrating LEED standards into building design criteria.
- Enbridge should be an advocate for energy efficiency to the federal and provincial governments.
- In smaller municipalities Enbridge could play an important role leading new energy efficiency and community outreach projects. Small municipalities often lack the capacity to adequately address energy efficiency.

Capacity Building and Training

- In general, the planning profession has not integrated energy management effectively into their plans and policies. Enbridge could play an important role educating municipalities and communities about how to integrate energy management into planning.
- Municipal building operators need to be trained on how to use new technologies and products so long lasting savings can be achieved.

Partnership Building

- The Association of Municipalities in Ontario could be a valuable partner to help Enbridge reach smaller municipalities.
- Municipalities are interested in a collaborative approach to energy management (electricity, gas, water, stormwater, etc.) and can act as a valuable partner for the implementation of Enbridge programs.
- In the future, municipalities will be undertaking municipal energy plans. Enbridge should partner with local municipalities on these initiatives and provide technical support/expertise.
- Cross jurisdictional organizations like the TRCA are facilitators of new conservation programs. Enbridge would be a welcomed partner in the implementation of energy conservation projects and initiatives.
- It is important that all utilities are involved in the formation of community energy plans as they can provide expertise and credibility into the process.

Comments on Existing DSM Programs

- A long term approach to energy efficiency is needed. In order for projects to be successful, all players need to commit to a project for the long-term and see it through to completion.

10 Conclusion and Next Steps

The next steps for the development of Enbridge's Plan for DSM programs from 2012 and beyond include:

- Preparing a detailed preliminary plan for each sector;
- Consulting with stakeholders on the preliminary sector plans;
- Obtaining approval from the OEB for the Final Plan;
- Reporting back to stakeholders on the Final Plan; and,
- Consulting with stakeholders on the implementation of the Plan.

SETTLEMENT AGREEMENT

ENBRIDGE GAS DISTRIBUTION INC.

DEMAND SIDE MANAGEMENT

MULTI-YEAR PLAN 2012-2014

TABLE OF CONTENTS

I. BACKGROUND AND CONTEXT

On June 30, 2011, the Ontario Energy Board ("OEB" or the "Board") issued a letter (the "Letter") and the new Demand Side Management ("DSM") Guidelines for Natural Gas Utilities ("Guidelines") developed in the EB-2008-0346 proceeding. The Letter provided that the natural gas utilities were expected to develop their Multi-year DSM Plans in accordance with the Guidelines and to submit them to the Board for approval by September 15, 2011. As a result of requests for extension made by Enbridge Gas Distribution Inc. ("Enbridge"), the Board extended the filing date for Enbridge to Friday, November 4, 2011. Contemporaneously with the filing of this Agreement with the Board, Enbridge has filed its application for approval of its DSM Plan for 2012 – 2014.

The Guidelines contemplate that gas distributors will consult with their stakeholders with respect to their DSM Plans. The extension requests referred to above were made as a result of ongoing discussions between Enbridge and DSM Intervenors in the hope of reaching a consensus in respect of all or some aspects of Enbridge's Multi-Year DSM Plan. This Agreement is the result of these discussions.

On July 20, 2011, Enbridge held a DSM Consultative meeting and invited the Consultative to constitute a small working group to review the Company's proposed DSM Plan and work with the Company with the goal of achieving agreement on the Plan's budget allocation, scorecard, metrics and targets. The Consultative requested that, rather than working with one select group of stakeholders, the Company hold a series of open meetings on various topics related to the DSM Plan, such that any Consultative members could take part on those topics of interest to them. The Company then convened a series of meetings based on Program Type as defined in the Guidelines (Low Income, Market Transformation, and Resource Acquisition).

In effect, a working group emerged for each program type. The Consultative members that chose to serve on each of the Working Groups, in addition to Enbridge representatives, were:

Working Group	Members
Low Income	Chris Neme (GEC) Marion Fraser (LIEN) Jack Gibbons (Pollution Probe) Roger Higgin (VECC)
Market Transformation	Julie Boudreau (BOMA) Vince DeRose (CME) Chris Neme (GEC) Marion Fraser (LIEN) Jack Gibbons (Pollution Probe)

Working Group	Members
Resource Acquisition	Julie Boudreau (BOMA) Julie Girvan (CCC) Vince DeRose (CME) Chris Neme (GEC) Ian Mondrow (IGUA) Marion Fraser (LIEN) Jack Gibbons (Pollution Probe) Jay Shepherd (SEC) Roger Higgin (VECC)

Meetings between Enbridge and the Working Groups took place on the following dates:

Plenary	August 9, 2011
Low Income	August 16 and 18, 2011
Market Transformation	August 23 and 25, 2011 and a conference call on August 26, 2011
Resource Acquisition	August 30, 31, September 7, 14 and 15, 2011
Plenary	September 21, 2011

The purpose of these meetings was to allow members of each Working Group to ask specific questions and request information for review in support of Enbridge's DSM Plan. A further goal was to determine whether a consensus could be reached in respect of all or some aspects of the proposed DSM Plan and, in particular, "the financial package" consisting of the allocation of budget as between program types, any permitted budgetary increases, metrics, scorecards and incentive levels.

The Working Groups ultimately reached consensus with Enbridge on the financial components of the DSM 2012 Plan, as more particularly set out in this Agreement, with the exception of the two unsettled issues noted below. These terms were then shared with the broader DSM Consultative, including at a meeting held on September 21, 2011, at which time the terms contained in this Agreement were presented and adopted by the following members of the DSM Consultative (Enbridge and the Intervenors listed below being hereinafter referred to as the "Parties"):

Building Owners and Managers Association (BOMA)
Consumers Council of Canada (CCC)
Canadian Manufacturers & Exporters (CME)
Energy Probe Research Foundation (Energy Probe)
Green Energy Coalition (GEC)
Industrial Gas Users Association (IGUA)
Pollution Probe
School Energy Coalition (SEC)
Vulnerable Energy Consumers Coalition (VECC)
Federation of Rental Providers of Ontario (FRPO)
EnviroCentre
Low Income Energy Network (LIEN)

II. AGREEMENT PREAMBLE

As a result of the consultative process described above, the Parties have reached agreement on a "financial package" which allocates the budget to various program types, sets targets and metrics on scorecards and the levels of incentive payments. In addition, as a result of a further consultative process, the Parties and Union Gas have reached agreement on the Terms of Reference for Stakeholder Engagement which establishes the guidelines for program review, evaluation, audit, and all other aspects in which stakeholder engagement is involved. These agreements are set out in this document (hereinafter the "Settlement Agreement").

This document is not a Settlement Agreement in the traditional sense under the Board's Rules of Practice and Procedure, for at least three reasons. First, it was not the result of a process ordered and supervised by the Board. Second, because of the varied nature of the subject matter, the Parties determined that it would be more productive if not all Parties attended all meetings. Third, Board Staff were not present at all of the meetings.

Notwithstanding that this is not a formal Settlement Agreement under the Rules, the Parties jointly present it to the Board as their binding and enforceable Agreement with respect to the issues discussed herein. The Parties request that the Board accept it as evidence of their consensus on those issues, and, subject to any further discovery or other process the Board requires to deal with the Application, deem it to be a Settlement Agreement under the Board's Rules.

The Parties further request that the Board adopt this Agreement as part of the Board's Decision and Order in this application. While the consultative process, under which this Settlement Agreement was reached, was not formally initiated by the Board under Rule 31 of the *Ontario Energy Board Rules of Practice and Procedure*, the parties agree that it is appropriate that Rules 31.09, 31.10 and all of 32 apply to the consultation process and to this Settlement Agreement.

The evidence which supports this Settlement Agreement is found in the Plan Submission. The Parties were provided with a full copy of the Plan Submission for their review prior to finalization of this Settlement Agreement. The Parties are of the view, not only that this record supports this Settlement Agreement, but that also the quality and detail of the record provide a basis for the Board to approve this Settlement Agreement.

The Parties all agree that this Settlement Agreement is a package: the individual aspects of this agreement are inextricably linked to one another and none of the parts of this settlement are severable. As such, there is no agreement among the Parties to settle any aspect of the issues addressed in this Settlement Agreement in isolation from the balance of the issues addressed herein. The Parties agree, therefore, that in the event that the Board does not accept this Settlement Agreement in its entirety, then there is no agreement. If the Board does not accept this Settlement Agreement, all Parties will be at liberty to take such positions as they see fit in respect of this DSM Plan Application filing and to file such additional and further materials in support of such revised position. In addition, in the event that this Settlement Agreement is rejected by the Board, the position of each of the Parties will not be prejudiced by reason of their participation in settlement discussions and entry into this Settlement Agreement.

According to the Board's *Settlement Conference Guidelines* (p. 3), the Parties must consider whether a settlement proposal should include an appropriate adjustment mechanism for any settled issue that may be affected by external factors. The Parties consider that no settled issue requires an adjustment mechanism other than those expressly set forth herein.

None of the Parties can withdraw from the Settlement Agreement except in accordance with Rule 32 of the *Ontario Energy Board Rules of Practice and Procedure*. Finally, unless stated otherwise, a settlement of any particular issue in this proceeding is without prejudice to the positions Parties might take with respect to the same issue in future proceedings. However, any such position cannot have the effect of changing the result of this Agreement.

The Guidelines contemplate the filing of a DSM Plan by Enbridge for the period 2012-2014. The Parties have agreed in this Settlement Agreement to terms for the 2012 year only, except where otherwise expressly set forth. More specifically, while this DSM Plan has a 3-year horizon, this Settlement Agreement settles the financial package for 2012. This Agreement has been negotiated and agreed to on the representation by Enbridge that it will file a 2013, or 2013-2014, DSM Plan some time in 2012. It is the expectation of the Parties, given the significant change in direction and inclusion of new initiatives and programs, that the 2013 or 2013-2014 DSM Plan filing will be materially informed by Enbridge's 2012 DSM activities which are the subject of this Settlement Agreement.

The Parties have agreed to the Terms of Reference for the period 2012 through 2014 with respect to Stakeholder Engagement, and those terms are expressed in a separate agreement to which Union Gas Limited is also a party. This separate agreement is hereby incorporated by reference and annexed to this Settlement Agreement as Appendix A. While Union Gas Limited is a party to the agreement in respect of the Terms of Reference, it is not a party to this Settlement Agreement.

III. TERMS OF SETTLEMENT

A. Introduction

The Guidelines, at Section 8, set a 2012 DSM budget for Enbridge of $28.1 million. Subsection 8.3 of the Guidelines provides that the 2012 budget may be increased by up to 10 percent, provided the funds are solely used to support low income programs. The Parties accept Enbridge's proposal that the budget should be increased by 10 percent (being an increase of $2.81 million) and, as noted below, the entire increase will be used to support low income programs. As a result the Parties agree to a total 2012 DSM budget of $30.91 million.

There is a partial settlement on the application of Section 11 of the Guidelines, "Incentive Payment". Given the increase in budget, depending upon the Decision of the Board, the maximum incentive available ranges from $9.5 million to $10.45 million. The issue outstanding is whether the increase in budget affects the quantum of the maximum incentive available. Should the Board determine that the incentive for 2012 is capped at $9.5 million, Enbridge may, at its discretion, decline to increase the budget for Low Income Programs by all or any portion of the $2.81 million.

For the purposes of this Agreement, all calculations of incentives have assumed the maximum total incentive of $10.45 million. In the event that the Board determines that the total incentive should be a different amount, and that Enbridge declines to increase the budget for Low Income, then the Low Income scorecard targets shall be reduced proportionately. The Resource Acquisition and Market Transformation budgets and targets would not change. However, the incentive allocation would be adjusted depending on the revised spending allocation across program types resulting from the change in spending on the Low Income program. The use of $10.45 million as the assumption in this Agreement is not intended to suggest that it is more likely to be the correct number, and the positions of the Parties on this issue shall not be prejudiced in any way by the use of this assumption for drafting and explanatory purposes.

Targets in this Settlement Agreement are linked to the budget proposed for each program type. In the event that the Board does not approve the proposed budget for any program type then the Settlement Agreement in respect of targets would not be approved and would need to be reopened

A summary of the budget amounts by each program type and the appropriate allocation of the maximum incentive available by program type are set out below. This is followed by a detailed description of the settlement in respect of each program type.

The budget for each program type has been agreed upon for 2012 only. The overall budget will then be increased for each of 2013 and 2014, as set out in Section 8 of the Guidelines or as otherwise determined when Enbridge's DSM plans for the 2013 and 2014 period are considered. The Parties will work towards achieving an agreement in respect of the allocation of budget to the several program types and in respect of any proposed research and development or pilot programs for each of 2013 and 2014.

The budget for each program type has also only been agreed at the top level (i.e. resource acquisition, market transformation, low income). This Agreement does not purport to indicate agreement on, or support for, any particularly existing or proposed program. Consistent with the theme of utility responsibility for program design and implementation, with stakeholder input only as requested by the utility, all as set out in Appendix A to this Agreement, except where expressly set forth in this Agreement the Parties have not agreed on a budget allocation to or between particular programs. Further, this Agreement does not purport to indicate agreement on, or support for, the proposed split between program spending and overhead spending, whether overall or within any program type.

Each program type has its own scorecard which contains the various targets and metrics applicable to relevant programs for 2012. In developing the scorecards, the Parties applied the rules set out in the Guidelines under Sections 9 and 10. For 2013 and 2014, the Parties will work towards achieving agreement on the appropriate scorecard with targets and metrics for each of the program types. In this way, the scorecard will be "tailored" to the suite of program offerings that Enbridge will be undertaking in 2013 and 2014.

Parties understand that the Evaluation Plan as filed by Enbridge is illustrative only with final decisions on evaluation priorities being made through the Technical Evaluation Committee process which is the subject of the Stakeholder Engagement Terms of Reference which are attached as Appendix "A".

Parties understand that, with respect to the Table of Measure Assumptions as filed by Enbridge, the agreement does not cover any new assumptions that are referenced as being added by Union. Further, this agreement does not cover the part of the Assumptions Table related to the designation of measures as "Union deep measures".

Parties understand and accept that Enbridge's DSM Plan filing does not contemplate incurring any R&D or pilot program costs in 2012. If, however, circumstances arise where R&D or the roll out of a pilot program becomes appropriate in 2012, Enbridge acknowledges that monies expended on R&D or pilot programs are not eligible for an incentive and such expenditures will thereby reduce the maximum incentive to which Enbridge is eligible by the same percentage that R&D and pilot program spending represents of the total budget. For example, if Enbridge spends one percent of its budget on R&D and pilot programs, the maximum incentive will be reduced by one percent.

The maximum incentive available by program type has been determined by calculating the budget for each program type as a percentage of the total budget. By applying this percentage to the maximum incentive payment available of $10.45 million, the incentive available by program type is determined.

This Settlement Agreement shall be filed contemporaneously with Enbridge filing its 2012 - 2014 DSM Plan. Enbridge agrees that the DSM Plan it files will be the same in all material respects as the DSM Plan provided to the Parties prior to the execution of this Agreement. Intervenors are entitled to ask further questions about Enbridge's DSM Plan, including but not limited to any programs and activities (the term activity hereinafter refers collectively to program offers, activities and initiatives) which Enbridge contemplates delivering and undertaking over the course of the Plan. Parties agree, however, that they will not take any position in respect of any program or activity which, if sustained by the Board, would necessarily result in a change to any of the terms, targets, metrics, budgets or incentives set out in this Settlement Agreement.

B. Unsettled Issues

There are two issues that are not the subject of a complete settlement and for which guidance from the Board is requested. The Parties agree to the description and the scope of the unsettled issues as set out below.

(i) Impact of Low Income Budget on Maximum Incentive

This Settlement Agreement contemplates increasing the DSM budget set out in the Guidelines for Enbridge by $2.81 million and to spend all of this increase on Low Income Programs. There is a complete settlement and agreement on this budget increase.

There is a partial settlement in respect of whether the maximum incentive available is increased in proportion to the increase in budget for Low Income Programs. All parties agree that if the maximum incentive is increased to reflect the increase in budget, the maximum total incentive is $10.45 million. Enbridge and the Parties identified below that support the partial settlement take the position that the maximum incentive may be increased to $10.45 million given the increase in the Low Income budget. Other Parties, as identified below, either seek clarification from the Board, or take no position on this issue.

Participating Parties: All parties participated in this issue.

Partial Settlement: The following Parties support increasing the incentive to $10.45 million: Enbridge, BOMA, GEC, LIEN, Pollution Probe, EnviroCentre, and VECC

The following Parties seek clarification from the Board: CCC, CME, Energy Probe, FRPO, and SEC

The following Parties take no position: IGUA

(ii) Allocation of Low Income Program Costs and Overheads

The Parties note that the Guidelines, at Subsection 8.3, state the following:

> "The Board is of the view that the Low Income DSM budget should be funded from all rate classes, to be consistent with the electricity conservation and demand management framework, as well as the LEAP Emergency Financial Assistance Program."

All costs associated with Enbridge's LEAP Emergency Financial Assistance Program activities are allocated based on distribution revenue. The Parties seek clarification from the Board as to whether the allocation of all Low Income Program costs and overhead, based on distribution revenue, is consistent with the Guidelines.

C. 2012 Budget and Maximum Shareholder Incentive Totals

i) By Program Type

Program Type	Program Costs	Overheads	Total	%	Maximum Incentive
Resource Acquisition	$15,125,000	$3,926.400	$19,051,400	61.64%	$6,440,865
Low Income	$6,120,650	$904,350	$7,025,000	22.73%	$2,375.000
Market	$3,920,000	$913,600	$4,833,600	15.64%	$1,634,135

Program Type	Program Costs	Overheads	Total	%	Maximum Incentive
Transformation					
TOTAL	$25,165,650	$5,744.350	$30,910,000	100%	$10,450,000

D. Details of Settlement by Program Type

(A) Resource Acquisition

(i) Budget

Budget ($Million) (including overheads)
2012 $19,051,400

(ii) 2012 Resource Acquisition Scorecard

Component	**Metric**	**Weight**	**Lower Million m^3**	**Middle Million m^3**	**Upper Million m^3**
Volumes	Lifetime cubic meters	92%	615.3	820.4	1025.5
Residential Deep Savings	Number of participants with at least 2 major measures and at least 11,000 lifetime m^3 savings *(average annual gas savings across all participants must be at least 25% of combined baseline space heating and water heating usage for any incentives to be earned)*	4%	120	160	200
Commercial – Industrial Deep Savings	Percent of custom C&I participants with at least 25% annual gas savings	4%	40%	45%	50%

(iii) Maximum Incentive

The Resource Acquisition budget as a percentage of total budget ($19.051 million as a percentage of $30.91 million, equals 61.64 percent). 61.64 percent of a maximum incentive of $10.45 million equals $6.440 million, which is the maximum incentive for Resource Acquisition, payable if the "Upper" level for each metric on the scorecard is achieved in 2012.

(iv) Specific Terms with Respect to Resource Acquisition

(a) Enbridge intends to utilize $1.9 million of the Resource Acquisition budget in the Energy Compass/Run it Right activity. Except as noted in (b) below, none of the cubic meters of gas saved in 2012 from this activity may be included for the purposes of calculating Enbridge's 2012 Resource Acquisition Scorecard performance. In the event that Enbridge shifts funds from the Energy Compass/Run it Right activity to any other program or activity, the "lifetime cubic meter" targets at all three levels (i.e., lower, middle and upper) shall increase by 50 cubic meters for each dollar shifted. For example, if Enbridge shifts $500,000 to other programs or activities, the targets are increased by 25 million cubic meters, i.e., to 640.3; 845.4 and 1050.5 million m^3.

(b) Capital improvement projects, or "Custom Projects", that are identified by the Energy Compass/Run it Right activity reviews are not considered to be part of the results from Energy Compass/Run it Right for the purpose of (a) above. The lifetime cubic meters achieved from those Custom Projects completed in 2012 will be included for the purpose of calculating scorecard performance in the same manner as if they had not been identified through Energy Compass/Run it Right.

(c) The Energy Compass/Run it Right activity is intended to contribute natural gas savings towards the 2013 and subsequent year's savings targets and scorecard performance. The spending in 2012 on the Energy Compass/Run it Right activity therefore shall be considered a program cost under the Resource Acquisition budget.

(d) The Residential Deep Savings Target shall be based on the number of homes retrofitted. On average, the customers counted towards the deep savings metric must achieve at least a 25% reduction in annual gas usage for space and water heating, in aggregate (also based on HOT2000 software used in EnerGuide mode), for the utility to be eligible to earn any shareholder incentive. In addition, each participant must a) achieve a minimum gas savings of 11,000 lifetime m^3 (based on HOT2000 software used in EnerGuide mode), and, b) implement a minimum of 2 major measures. The following are examples of major measures:

(i) Heating system replacement

(ii) Water heating system replacement

(iii) Attic insulation

(iv) Wall insulation

(v) Foundation insulation

(vi) Air sealing (minimum reduction of at least 10% as measured by a blower door)

(vii) Window replacements

(viii) Drain water heat recovery

(e) The Commercial/Industrial Deep Savings Target will be based on the percentage of Commercial/Industrial Custom Project participants that achieve 25% or greater annual gas savings .This will be calculated by comparing, for each participant, the forecast weather normalized annual gas savings from the custom project against the actual weather normalized consumption of the participant for the immediately preceding year. If a prescriptive boiler rebate is provided in addition to other custom measures, its savings will still be included for the purpose of calculating the total project savings.

(f) Enbridge will commission an Industrial Free-Ridership study, designed to allow estimation of free ridership separately for small (less than 0.3 million annual m^3 consumption), medium (between 0.3 million and 1.5 million annual m^3 consumption) and large customers (greater than 1.5 million annual m^3 consumption), to update input assumptions for this sector. The Parties acknowledge that the lifetime cubic meter savings targets (Lower, Middle and Upper) for the Resource Acquisition program portfolio are predicated on the placeholder assumption that the free ridership rate for all industrial customers of all sizes is 50%. It is agreed that the free-ridership for small and/or medium sized industrial customers shall remain at 50% for 2012.

(g) Upon an Intervenor who is party to this Agreement executing an appropriate Declaration and Undertaking, Enbridge will, for the purpose of allowing that Intervenor to review the assumptions underlying this Agreement, provide to that Intervenor at least one week prior to filing its 2012 DSM Plan an electronic copy of the 2008 through 2012 TRC spreadsheets at their current level, subject to appropriate redaction protecting the identities of individual customers/businesses.

(h) Enbridge may access the DSMVA to achieve Resource Acquisition program performance in excess of 100%.

(i) Enbridge will have the right, in the manner described in the Guidelines, to re-allocate budget between customer classes and groups to optimize the effectiveness of its DSM Plan. However, the Parties agree, for 2012 only, that the total budget spent on programs and activities (not including overheads, Market Transformation, and Low Income Allocations) for all customers in rate classes 110, 115 and 170 shall not exceed $2.709 million, of which the total budget spent on programs and activities (not including overheads and Low Income Allocations) for industrial customers in those rate classes shall not exceed $1.797 million. These amounts are inclusive of any amounts drawn from the DSMVA. The purpose of this dual limit is to ensure that the total unit cost to be borne by customers in these rate classes is capped, but that non-industrial customers in these rate classes still have access to sufficient availability of funds in excess of budgeted amounts to participate in incremental (relative to budget) delivery of cost-effective programs. The Parties agree that this limitation is intended to be a transitional provision for one year only, and the Parties confirm their mutual intent to discuss more long-lasting provisions that could address the concerns of all customers in these three rate classes.

(C) Low Income

(i) Budget

Budget ($Million) Including overheads
2012
$7,025.00

(ii) 2012 Low Income Scorecard

Cumulative Savings (million m^3)	50%	100%	150%	Weight
Single Family (Part 9)	12	17	21	50%
Multiresidential (Part 3)	33	45	56	50%
TOTAL CUMULATIVE SAVINGS	**45**	**62**	**77**	**100%**

(iii) Maximum Incentive

The Low Income budget as a percentage of total budget ($7.025 million as a percentage of $30.91 million, equals 22.73 percent). 22.73 percent of a maximum incentive of $10.45 million equals $2.375 million.

(iv) Specific Terms of Agreement Relating to Low Income

(a) The Low Income budget includes an average of $300 for each single family home to treat for health and safety issues necessary to implement energy efficiency upgrades. This average value is used, recognizing that the need, cost and actual expense for such health and safety work will vary from home to home.

(b) Enbridge agrees to comprehensively treat all cost-effective opportunities in each building, defined as all measures with a TRC benefit-cost ratio of at least 0.7 (as per Board Guidelines).

(c) Enbridge will amalgamate the Low Income TAPS and weatherization activities. All low income single family homes visited for potential weatherization will, wherever possible, receive the basic measures (i.e., showerheads and programmable thermostats) as part of the home assessment visit. Stand alone Low Income TAPS will no longer be offered.

(d) Enbridge will investigate a rental initiative for energy efficient furnace and water heaters, to be delivered by third party providers, as a way of assisting low income customers to reduce their energy consumption. The initiative will not involve a re-entry by Enbridge into the equipment rental business.

(e) Social and assisted housing (Part 3 of Division B, of the Ontario Building Code) buildings are eligible for equipment and retrofit measures.

(f) The Run it Right activity will be offered to all program eligible multi-residential buildings.

(g) Program tracking on participants will follow ownership (i.e., private, social and assisted housing).

(h) Enbridge may access the DSMVA to achieve Low Income program performance in excess of 100%.

(i) All parties agree that the available 10% increase in budget set forth in Subsection 8.3 of the Guidelines shall be used for Low Income programs only.

(D) Market Transformation

(i) Budget

Budget ($Million) (including overheads)
2012
$ 4.83

(ii) 2012 Market Transformation Scorecard

2012 MARKET TRANSFORMATION SCORECARD

Sector Program	Description	Sector Program Scorecard Value	Weight (%)	Targets: Lower Band	Targets: 100%	Targets: Upper Band
New Construction Commercial: Savings By Design	Builders/Developers Enrolled	**100.00%**	**20.00%**	6	8	15
New Construction Residential: Savings By Design	Top 20 Builders Enrolled	20.00%	14.60%	1	2	3
	Top 80 Builders Enrolled	20.00%	14.60%	7	9	18
Drainwater Heat Recovery	Number of units installed	60.00%	43.80%	3,000	4,000	5,000
	Total New Construction Residential:	**100.00%**	**73.00%**			
Existing Residential: Home rating at time of sale	Commitments to make a provision for data field to show a home's energy rating for all homes listed by participating realtors (industry-wide commitment to include such a field on MLS or similar listing service and/or individual realtors' commitment to do so with all the homes they list on their own websites, handouts, and other consumer material)	**100.00%**	**7.00%**	N.A.	Commitment from realtors collectively responsible for more than 5,000 home listings/year.	Commitment from realtors collectively responsible for more than 10,000 home listings/year.

(iii) Maximum Incentive

The Market Transformation budget as a percentage of total budget ($4.83 million as a percentage of $30.91 million) equals 15.64 percent. 15.64 percent of a maximum incentive of $10.45 million equals $ 1.634 million.

(iv) Specifics of Market Transformation Settlement

(a) The parties agree that the 2012 Savings by Design (Residential and Commercial) targets as set forth above will be reset for 2013 and 2014 based on lessons learned from the initial program year's experience, including Enbridge's enhanced understanding of key market participants, including builder/developers.

(b) Enrollment for participation in the Savings by Design program for commercial buildings will be set at a minimum building size of 100,000 square feet.

(c) For the purposes of assessing performance in 2012 relative to the Market Transformation metrics for the residential and commercial Savings by Design programs outlined above, only builders and developers who have "enrolled" in the program and completed the IDP process in 2012 are eligible to be counted towards the 2012 target.

"Enrollment" is defined as a signed Memorandum of Understanding (MOU) with a builder or developer containing a commitment to participate in the Enbridge Savings by Design program for a 3 year period which will include undertaking an integrated design process ("IDP") adhering to an Enbridge approved IDP process (such as IEA Task 23 or the iiSBE developed IDP Tool) which also includes the requisite energy model, all demonstrating how to achieve at least 25% total energy savings relative to the Ontario Building Code.

Enbridge will also provide performance incentives to Builders who are enrolled in the initiative for units constructed to the increased level of performance during the commitment period. Note that builders must complete the IDP to be eligible for the follow-on building incentive. Participating builders will be expected to construct units at the higher level of efficiency as part of the MOU.

Also, as part of enrollment, participants may be requested to allow Enbridge to feature their project in marketing and outreach materials and to use the project as part of a demonstration effort. Finally, participating builders may be asked to sit on a best practices committee that will assist in the delivery of the initiatives(s) within Enbridge's franchise.

The new construction process has a lead time to complete construction that can range from 10 months to 2 years. In the first year of the Savings by Design initiative the objective is to establish a baseline of builders and developers who are able to design and construct buildings that are 25% better than OBC. In 2013 and 2014 metrics and targets related to the number of units that are constructed to that level will be proposed by Enbridge.

(d) Enbridge is committing to ramping down financial incentives for the drain water heat recovery program over the 2012 to 2014 period and exiting the market altogether after 2014. That commitment is reflected in the market transformation strategy outlined in the program design included in Enbridge's filing.

(e) In respect of the Home Labelling Program, Enbridge will commission market research and analysis to support the development of a more detailed design of a time-of-sale home labelling program for implementation in 2013 and beyond.

IV. EVIDENTIARY BASIS FOR SETTLEMENT

Exhibit B, Tab 1, Schedule 1	Background and Introduction
Exhibit B, Tab 1, Schedule 2	2012-2014 Plan Overview
Exhibit B, Tab 1, Schedule 3	Program Types: Budget, Metrics and Targets
Exhibit B, Tab 1, Schedule 4	Program Descriptions
Exhibit B, Tab 1, Schedule 5	Evaluation Plan
Exhibit B, Tab 1, Schedule 6	Stakeholder Engagement Plan
Exhibit B, Tab 2, Schedule 1	System Characteristics/Rate Allocation Analysis
Exhibit B, Tab 2, Schedule 2	Avoided Costs
Exhibit B, Tab 2, Schedule 3	TRC Analysis
Exhibit B, Tab 2, Schedule 4	Table of Measure
Exhibit B, Tab 2, Schedule 5	Substantiation Sheets
Exhibit B, Tab 2, Schedule 6	Table of Measure Lives
Exhibit B, Tab 2, Schedule 7	DSM Potential Study
Exhibit B, Tab 2, Schedule 8	Lura Report

APPENDIX "A"

(Attached)

Joint Terms of Reference

on

Stakeholder Engagement

for

DSM Activities

by

Enbridge Gas Distribution Inc.

and

Union Gas Limited

November 4, 2011

TABLE OF CONTENTS

1. Introduction and Background /C

i. Purpose of the Stakeholder Engagement Process

Stakeholder engagement in Natural Gas Demand Side Management ("DSM") addresses needs of the intervenors that represent ratepayer and environmental groups, the utilities, their customers, and the Ontario Energy Board (the Board). For ratepayer and environmental groups, stakeholder engagement provides insights into the activities of the natural gas utilities and an opportunity to provide input and participate in the direction of certain of those activities. This instills confidence in the audit and evaluation processes, including the accuracy of reporting and the calculation of the DSM Variance Account (DSMVA), Lost Revenue Adjustment Mechanism (LRAM), and utility incentives. It also provides confidence that program results are calculated using sound assumptions based on best available information. For the utilities and their customers, as well as stakeholders, the collateral benefits of stakeholder engagement include the development and enhancement of utility DSM programs. For the Board and utilities, stakeholder engagement results in reduced regulatory burden and reassurance that the utilities continue to deliver successful and cost effective DSM programs.

ii. Definitions

For the purposes of these Terms of Reference the following definitions apply:

Intervenors: Organizations and their representatives who were participants in the Board's consultation on the June 20, 2011 DSM Guidelines (EB-2008-0346) (the "Guidelines") or who have been granted Intervenor status by the Board in any subsequent DSM proceeding.

DSM Consultative: Consists of representatives of the relevant natural gas utility and the group of Intervenors and stakeholders who have agreed to participate on the utility's DSM Consultative.

Stakeholders: Groups or individuals who have an interest in Ontario DSM matters, including intervenors. Other stakeholders who are not intervenors may be customers, trade allies, delivery agents, experts and others.

iii. Objective of the Terms of Reference

The purpose of the Stakeholder Terms of Reference is to clarify and define the roles and responsibilities of Intervenors, other Stakeholders, the utilities, and the Board with respect to participating in the DSM stakeholder engagement processes proposed in this document. These include processes relating to program design, DSM measure input assumptions, evaluation research, and the audit of DSM program annual results. These Terms of Reference and the consensus approach outlined herein are expected to lead to both greater objectivity on DSM technical standards and improved efficiency and effectiveness of stakeholder engagement through the period of the 2012 – 2014 Multi-Year Plans of Enbridge and Union.

iv. Background to the Terms of Reference

As outlined in the Guidelines, Union and Enbridge have jointly developed Terms of Reference for Stakeholder Engagement in cooperation with their stakeholders. The Utilities consulted with intervenors to reach agreement on the Terms of Reference, and are submitting the Terms of Reference to the Board as part of their DSM Plans for 2012-2014.

In developing the Terms of Reference, the Intervenors and utilities held several negotiation sessions, first with an Intervenor nominated Working Group followed by two days of negotiation sessions with the broader DSM consultative members. This Terms of Reference represents an agreement between the parties listed below. To provide the Board context to the extent of the consultation process, the following dates represent sessions that were held with either the smaller Working Group or the broader members of the DSM Consultative:

- The Working Group held 4 half-day sessions on August 19, 22, 24, and 26 as well as a two hour conference call on August 31.
- Discussions resumed on October 3 and 4 with the full DSM Consultative and agreement was reached on the Terms of Reference as described in this document. The parties to the Settlement Agreement are:

  Building Owners and Managers Association (BOMA)
  Consumers Council of Canada (CCC)
  Canadian Manufacturers & Exporters (CME)
  Energy Probe Research Foundation (Energy Probe)
  EnviroCentre
  Federation of Rental Providers of Ontario (FRPO)
  Green Energy Coalition (GEC)
  Industrial Gas Users Association (IGUA)
  Low Income Energy Network (LIEN)
  Pollution Probe
  School Energy Coalition (SEC)
  Vulnerable Energy Consumers Coalition (VECC)

The Terms of Reference go beyond the minimum requirements for consultation as presented in the Board Guidelines, Section 16.1.

In addition to two plenary Consultative meetings each year, the Terms of Reference provide for collaborative involvement between utilities and intervenors in:

- development and update of input assumptions**;**
- evaluation research priorities and individual studies**;**
- the audit of DSM annual results; and

- development of new program ideas.

The Terms of Reference also provide for involvement of other stakeholders in:

- development and update of input assumptions, and
- development of program ideas

2. Models for Intervenor and Stakeholder Engagement in the Utilities' DSM Activities /C

The model for intervenor/stakeholder engagement in the 2007 Multi-year Plan involved separate processes for the two natural gas utilities as follows:

- a minimum of two Consultative meetings each year; and
- creation of utility specific Evaluation Audit Committees ("EAC") to address matters relating to evaluation research and the audit of DSM annual results.

In addition, throughout the Plan period, the utilities consulted with their respective EACs prior to filing applications to update the measure assumptions used in their DSM programs.

The model proposed through this Terms of Reference document involves:

- a minimum of two plenary Consultative meetings each year for each utility;
- a common Technical Evaluation Committee ("TEC"), and a common Technical Reference Manual ("TRM") to document measure assumptions;
- a separate Audit Committee ("AC") for each utility;
- separate consultation in relation to Low Income Programs with intervenors and stakeholders; and
- provision for other consultation initiatives relating to program ideas for other program types

The proposed model offers several benefits.

- The division of functions will streamline both the process to update input assumptions and the audit process.
- The primary responsibility for critical review of evaluation research and input assumptions will rest with the TEC, thus streamlining the DSM audit process.
- The TEC will establish a common natural gas DSM technical body that will facilitate collaboration on evaluation research, and harmonization of DSM programs across the two utilities.
- The development of a common TRM represents best practice in DSM administration.

- The proposed model aligns with the Guidelines regarding
  - a minimum of two Consultative meetings each year for each utility; and
  - a common annual submission by the utilities to the Board to update input assumptions.
- In addition, the proposed models align with the two Board processes of
  - Disposition of DSM Deferral Accounts; and
  - Annual filing of Updated Input Assumptions.

3. Principles for Intervenor and Stakeholder Engagement for the Natural Gas Utilities /C

The following principles will guide intervenor and stakeholder engagement activities of the natural gas utilities.

Roles and Accountability

The utilities are responsible and accountable to the Ontario Energy Board for all their DSM activities. The Ontario Energy Board is responsible for approving DSM programs and related matters.

General

- Stakeholder engagement activities are undertaken to inform all parties on DSM program activities, to obtain each party's perspectives on the utility proposed program activities, and to establish alignment among parties on each utility's annual results.
- Intervenors and Utilities involved in stakeholder engagement processes should work in a constructive manner to improve the design, development and implementation of DSM programs in a timely fashion.
- Utilities and Intervenors will ensure that each committee has timely and complete access to all information necessary to carry out their functions.
- All processes that involve evaluation research, input assumptions, or audit of results shall be characterized by independence and transparency.

Consensus

- Unless otherwise stated, achievement of consensus is an objective but not a requirement of committee processes outlined in this Terms of Reference.
- Consensus is reached when all parties can sign on to a recommendation or position as in a settlement agreement to a Board proceeding.
- Where consensus is not reached, parties may file their separate positions with the Board.

Conduct of Committees

- Each committee will establish at the outset of each year of a plan period, a set of business conduct rules that will be used as guidance to ensure the constructive operation of that committee. For example the business conduct rules could cover items such as meeting participation or providing substitute participants, providing documentation with appropriate lead times, and participation in a constructive manner to support positive outcomes.

Committee Meetings

- In order to meet Board set deadlines or committee defined work schedules, where scheduling does not permit full attendance at committee meetings, each committee will convene meetings based on quorum, where quorum is defined for the Audit Committee as the utility plus two thirds of the intervenors and for the Technical Evaluation Committee as two utilities and three of the five other members of which two must be intervenors. For the purposes of achieving a quorum, participation by conference call, video link, or other electronic format is acceptable.

Confidentiality

- Non-disclosure agreements must be signed by participants when dealing with draft reports and study working documents and other documents as referenced for individual Committees. (refer to Appendix A)
- If any confidential information could potentially give the recipient an unfair business advantage in competing for work from the utilities, the utilities will "flag" such concerns in advance of providing the information and the potential recipient will have to choose to either: (1) not review the confidential information and remove himself / herself from the portion of the engagement process related to the confidential item; or (2) accept and review the confidential information but commit to not pursuing the work opportunity.

Conflict of Interest

- In the case of a conflict of interest arising, it is the participant's responsibility to declare the conflict to the Committee as early as possible.

4. Consultative Meetings **/C**

As outlined in the Guidelines, the utilities will each hold a minimum of two plenary meetings of their respective DSM Consultative in each calendar year and all intervenor participants in the Board's consultation on the development of the Guidelines (EB-2008-0346) and the most recent or current proceeding will be invited to the Consultative meetings.

The subject of the meetings may include:

- reviewing annual DSM results;
- selecting any subcommittee that may be part of the processes described in this Agreement (the TEC and the two ACs); and
- providing advice on the development and operation of the natural gas utilities' DSM Plan as well as on the design and development of new programs.

5. Technical Evaluation Committee Terms of Reference /C

There will be one Technical Evaluation Committee (TEC) for both natural gas utilities which will act as an independent body.

i. Goal

The goal of the TEC is to establish DSM technical and evaluation standards for natural gas utilities in Ontario.

ii. Scope of Work

- The TEC will make recommendations to the OEB on the annual Technical Reference Manual (TRM) Update.
- The TEC has accountability to:
    - produce and maintain a prioritized annual work list (by consensus)
    - establish evaluation priorities and specify future evaluation studies to be undertaken – execution of all work defined by the TEC is subject to the utilities' resource constraints (such as funding, personnel resources, time limitations); and
    - Review and reach consensus on the design and implementation of evaluation studies to be carried out including determination of whether the work is done by utility staff, the TEC technical consultant or third party firms.

iii. Composition and Selection

The Technical Evaluation Committee shall consist of seven individuals:

- three intervenor members selected by intervenors in accordance with footnote 34 of Subsection 16.1 of the Guidelines;
- two utility members - one from Union and one from EGD, self selected by each utility. (Other representatives from the utilities may attend Committee meetings from time to time but are not voting Committee members.); and
- two independent members with technical and other relevant expertise, selected from the public, to add independence and objective perspective to the TEC. Selection is by

consensus among utility and intervenor members or no one is appointed and the Committee does not become established until a consensus is achieved.

The structure of the Committee is to be similar to a corporate Board of Directors which has representation from shareholders, management, and independent members.

The independent members are expected to provide professional expertise in relation to evaluation and to the development of input assumptions, encompassing experience in residential, commercial and industrial applications such as energy efficiency in low rise buildings, commercial buildings, industrial processes, market transformation, and so on.

iv. Term

For the first year, independent members and intervenor members will be appointed for one year with an opportunity for reappointment. The goal is to achieve continuity in the longer term.

v. Process

- It is anticipated that approximately twelve monthly meetings (1/2 to a full day each) will be held in the first year. Fewer meetings may be required in years two and three.
- Any member may call for a meeting on reasonable notice and bring items forward for discussion by the TEC. The utilities shall be jointly responsible for scheduling meetings.
- Regarding confidentiality: Committee members will be expected to review Final Evaluation Reports and to review draft reports and other study work products as determined by the Committee's workplan. Regarding evaluation studies, Final Reports will not be considered confidential unless necessary to prevent disclosure of sensitive customer data (including data that could be potentially linked to individual customers even if the customers' names are redacted). Draft reports and study work products will initially be considered confidential unless otherwise determined by the Board in a proceeding and will be available on signing the Declaration and Undertaking attached as Appendix "A".
- The Committee will endeavour to reach consensus on its recommendations. Where consensus is not reached, the Committee members will outline their respective positions in the appropriate Board processes (application to clear DSM Deferral Accounts, annual submission to Update Input Assumptions, or DSM Plan application).
- One firm will be secured as a general technical consultant for the TEC to meet a workload as defined by consensus of the Committee but will not be considered a Committee member. The technical consultant is to be selected by consensus or no one is hired.
- Additional technical consulting firms may be secured based on the TEC's identification and prioritization.

- The assigned utility or technical consultant supervises the effort to complete the scope of work assigned by the TEC.
- The Technical Consulting firm will have a team that demonstrates a depth and breadth of technical and evaluation competencies for the purpose of managing the TRM and assisting with additional evaluation requirements as requested by the TEC.

vi. Outputs / Deliverables

Technical Reference Manual

- The TRM will be common to both Union and EGD and will document efficiency measure savings assumptions (and/or formulae) and all other assumptions (other than avoided costs) necessary for cost-effectiveness screening and program metrics. Input assumptions and formulae may be unique for each utility.
- The TRM may also include such other reference material as the Committee deems appropriate.
- The TEC will produce an annual Update to the TRM for the two utilities to file with the Board as per the Guidelines. This submission may be on a consensus or non-consensus basis.
- The Committee may also provide consensus recommendations to the Board throughout the year regarding TRM updates (e.g. new program input assumptions, free ridership rates).

vii. Timing and Interface with the Audit

In accordance with the Guidelines, the utilities will file the annual TRM Update submission as soon as practical after the completion of the annual audit process. The TEC will provide the latest Board approved TRM and any TRM recommendations from the TEC to the Auditor for the purpose of the audit. Unless the auditor brings forward new information with evidence, the updated TRM as approved by the Board, along with any TEC recommendations, will be considered best available information at the time of the audit.

viii. Fee Guidelines

Intervenor and independent members serving on the TEC will invoice the utilities for meeting attendance and preparation up to the appropriate rate established by the OEB. The invoices will document activities and intervenor and independent member time, and the cost will be equally shared between the two utilities. It is expected that the level of commitment for participation in this process will be on the order of 150 hours in the first year for each intervenor or independent member; it may be less in subsequent years. In the event additional hours are required, the Committee can re-visit the Committee's budget requirements.

ix. Roles and Responsibilities

Intervenor members

In addition to participating on the Committee, the intervenor participants will:

- report back to the intervenor members of the larger DSM Consultative in such manner as the intervenors determine;
- liaise with intervenor representatives on the AC; and
- at their discretion, file comments with the Board – particularly in the event that the Committee fails to reach consensus on the annual TRM update and/or the conduct of any evaluation work.

Utilities

In addition to participating on the Committee, the utilities will:

- alternate (between EGD and Union) as the Chair of TEC meetings;
- support the reasonable costs claims advanced by Committee members and costs of the technical consultant(s) retained;
- support all costs associated with the conduct of all evaluation research studies;
- bring draft evaluation research designs to the Committee for review and oversee the implementation of evaluation research studies in consultation with the Committee; and
- submit to the Board the annual application for the TRM Update as soon as practical after the audit's completion. The TRM Update will identify all changes to existing assumptions, all new assumptions and make clear whether any of the changes and additions were not the product of a Committee consensus.

Independent Members

The independent members will:

- provide professional expertise in relation to evaluation, the development of input assumptions and other DSM related technical matters brought before the Committee; and
- review the design and implementation of evaluation studies to be carried out by the utility.

Technical Consultant

The technical consultant will:

- be responsible for completing identified work as defined by the TEC.

The Ontario Energy Board

The role of the Ontario Energy Board is to:

- review recommendations relating to the annual filing of the Update to Input Assumptions; and
- where a consensus on the Update to Input Assumptions or the conduct of evaluation work is not achieved, to resolve any such dispute by way of Board Decision at the Board's discretion.

6. Audit Committee Terms of Reference /C

Each utility will have an Audit Committee.

i. Goal

The goal of the AC is to ensure that there is, each year, an effective and thorough audit of the utility's DSM results.

ii. Scope of Work

- The AC will establish, as part of the 2012 audit, the standard scope of the annual audit for the term 2012 to 2014 ("goals" versus "tasks").
- The standard scope will be used for the 2012 to 2014 term as part of the RFP and the AC may alter the scope annually based on consensus. The AC will provide the auditor with input and guidance (such as scope of work, review work plan/draft report and provide advice and direction).
- The AC will make recommendations based on the Audit Report regarding the utility's claims regarding DSM results and DSMVA, LRAM, utility incentives and any target adjustments through the AC Report submitted to the Board.

iii. Composition and Selection

Each utility will have an AC, which shall consist of four members:

- three intervenor members selected by intervenors in accordance with footnote 34 of Subsection 16.1 of the Guidelines. Intervenors selected may also sit on the TEC for continuity.

- one representative from the utility, self selected by each utility. Other representatives from the utility may attend Committee meetings from time to time but are not voting Committee members.

iv. Term

Intervenor members will be appointed for each year's audit process, eligible for reappointment for successive audits. In the event that a member must resign, the same process will be used to nominate and appoint a replacement.

v. Auditor Selection Process:

- Utilities will issue and maintain an ongoing RFQ to qualify audit firms to their pre-approval list
- Utilities and intervenors will seek consensus to identify a pre-approved list (from the RFQ) of a minimum of nine audit firms for consensus selection.
  - Where consensus on a firm for the pre-approved list is not achieved, the utility decides the firms on the pre-approved list, while ensuring that the minimum number of firms is still obtained.
  - Where disputes arise from a firm not being added to the bidders' list by the utilities, the intervenors may pursue this issue with the Board for decision at the time of the audit filing. (This may result in a potential delay of one year in a firm being added to the list.)
  - By consensus of the Committee, the minimum number of nine audit firms for bidding on the annual audit can reduced .
  - Because of utility procurement policies, no feedback will be provided to unsuccessful bidders, nor to any firm being excluded from the bidders' list.
- The utility will issue an RFP to hire an auditor, with the RFP being distributed to all of the firms on the pre-approved list. The RFP will make clear the criteria that will be used to select a winning bidder and that the selection is by a committee of intervenors and the utility. The standard set of selection criteria (categories, descriptions, and relative importance) for auditor selection will be established prior to the RFQ process for the 2012 audit.
- Utilities and intervenors will seek consensus on auditor selection
  - Where consensus on an audit firm selection from the proposals submitted is not achieved, the intervenors will decide the firm from among the proposals submitted by pre approved bidders.

- Disputes arising from a non-consensus firm selected as the auditor will be given to the Board for consideration when the audit report is filed following completion of the audit.

vi. Process:

- The utility member will act as chair of the AC. The Chair does not have any extra powers or votes, but will chair the meetings.
- The utility will administer the audit contract and hold the auditor accountable to the terms of the contract.
- All communications are transparent to all AC members (exceptions will be identified by the AC at the beginning of the annual audit).
- The auditor, utility, and intervenors will work to ensure that the original scope of the audit is maintained and not allow “scope creep”.
- The auditor will receive guidance and direction from the AC (e.g. on the scope of work, draft work plans, and draft work products). However, the Auditor’s report and effort will be independent of utility or intervenor control or influence. (The AC cannot, for example, instruct the auditor on “how” to engage in their work, such as tools to use, methodology, processes used in the audit, how the auditor conducts the work and forms their opinion) and the final Audit Report must be filed with the Board without adjustment. For greater certainty, the utility and the intervenors may, at AC meetings, provide comments to the Auditor on drafts of the report, which the Auditor is free to accept or reject, but the Final Report must represent the independent professional opinion of the Auditor.
- Any member of the AC may call for a meeting on reasonable notice. It is the role of the utility to provide administrative support in the scheduling of all meetings.
- Meetings will be held from December through June, including possible joint meetings of the two audit committees, when necessary. It is expected that 9-10 meetings will normally be sufficient.
- The AC will endeavour to reach consensus on recommendations concerning the utility’s claims regarding DSM annual results. Where consensus is not reached, the Committee will outline areas of disagreement in the AC’s Report to the Board.
- Consistent with the principle of transparency, all verification reports, evaluation reports, summary spreadsheets, and other materials made available to the auditor, will be available on request, for review by all Committee members (with utility defined redaction of information to maintain privacy considerations) and on signing the Declaration and Undertaking attached as Appendix “A”.

vii. Outputs / Deliverables

The utility will file with the Board the

- Final Auditor's Report, having been reviewed by the Audit Committee, by June 30th as required by the Board's Natural Gas Reporting and Record Keeping Requirements Rules for Gas Utilities per page 41 of the Guidelines (EB-2008-0346).

The utility will also file the following reports by July 31st with the Board:

- the Audit Committee's Report, and
- the updated Final Annual Report.

viii. Fee Guidelines

Intervenor members will invoice the utility for time spent on Committee matters including meeting attendance and preparation up to the appropriate rate established by the OEB. The invoice will document activities. Intervenors will submit separate invoices to each utility with respect to the AC of that utility. It is expected that the level of commitment for participation in this process will normally not exceed 60 hours per year for each intervenor member. In the event additional hours are required, the Committee can revisit the Committee's budget requirements.

ix. Roles and Responsibilities

Intervenors

In addition to participation on the AC, the intervenor members of the Committee will:

- represent the larger Consultative's comments arising out of the Draft Annual Report and bring forth any issues/concerns expressed
- review and submit to the Auditor comments on the utility's draft Annual Report; and
- at their discretion, file comments with the Board – particularly in the event that the Committee fails to reach consensus on the selection of the auditor, the conduct of the Audit, the Final Annual Report, and/or the Audit Committee Report filed by the utility.

The Utilities

In addition to participating on the Committee, the utilities will:

- act as chair of the AC and provide the Draft Annual Report to the DSM Consultative and to Committee members;
- respond to issues that arise out of the audit process;
- update the Annual Report after the audit has been completed;
- support all costs associated with the Auditor and the Audit through the DSM evaluation budget;
- support the reasonable cost claims advanced by Committee members;

- file with the Board the Audit Report, the Final Annual Report and the Audit Committee Report, noting in the process if any elements of the Final Annual Report and the Audit Committee Report do not represent the consensus of the AC.

The Auditors

The Auditors shall, at a minimum:

- provide an audit opinion on the DSMVA, LRAM and utility performance incentive amounts proposed by the natural gas utility and any amendment thereto;
- confirm any target adjustments have been correctly calculated and applied;
- identify any input assumptions that either warrant further research or that should be updated with new best available information;
- review the reasonableness of any verification work that has been undertaken to inform utility results; and
- recommend any forward-looking evaluation work to be considered.

The Ontario Energy Board

The role of the Ontario Energy Board is to:

- review recommendations relating to the Audit Committee Report and utility application for clearance of DSM Deferral accounts; and
- where a consensus on the Audit Committee Report is not achieved, the Board will resolve any disputes by way of Board Decision at its discretion.

7. Program Consultation /C

Each utility will undertake separate utility-led consultation initiatives.

i. Objective

The objective of stakeholder engagement in DSM programs is to enhance the development of effective and innovative DSM programs. The utilities will establish DSM programs through individual consultation processes engaging intervenors and stakeholders.

ii. Scope of Program Consultation

Each utility commits to holding at least two plenary consultations with intervenors each year.

In addition, the utilities commit to holding two joint full day meetings a year for consultation on Low Income programs (one in the first quarter and one in the fall). The meetings will be structured to allow for plenary discussion as well as breakout sessions to discuss matters specific to each utility. The meetings will include intervenor representatives as well as other stakeholders. The overall focus of the meetings will be on program design and implementation rather than program status and regulatory matters. The objectives of the consultation sessions are:

- For intervenors and other stakeholders to provide their perspective on the delivery of current programs
- To learn from intervenor groups and stakeholders how they can support the utilities in achieving the targets for Low Income DSM Programs
- To discuss ideas presented by intervenors and stakeholders for new / improved Low Income DSM Programs.

The utilities will consult with representatives of LIEN and VECC regarding the agendas and invitation lists for the Low Income sessions.

The utilities may also, at their discretion, consult with Intervenors and stakeholders on program design and implementation relating to other program types in their DSM portfolios.

Appendix "A"

IN THE MATTER OF THE *Ontario Energy Board Act 1998,* 1998, s. 15 (Schedule B);

AND IN THE MATTER OF an Application or Applications by **[insert Utility Name]** ("   ") for an Order or Orders granting approval of initiatives and amounts related to **[Utility's]** Demand Side Management Activities ("DSM") and all related and associated DSM Consultatives and Technical and Audit Committees

DECLARATION AND UNDERTAKING TO (insert Utility Name or Names)

I, ______________________________________, am counsel of record or a consultant for ____. In the event that I serve on **[Name of Utility]** DSM Consultative, Audit Committee, or Technical Evaluation Committee (singularly or collectively the "Committee"), I agree to be bound by the Declaration and Undertaking.

DECLARATION

I declare that:

1. I have read the *Rules of Practice and Procedure* of the Ontario Energy Board (the "Board").

2. I am not a director or employee of a party to any Board proceeding for which I act or of any other person known by me to be a party in any Board proceeding.

3. I understand that this Declaration and Undertaking applies to all information that has not already been made public and in respect of which [**Utility]** makes a written claim of confidentiality that I receive in a Committee process and any subsequent Board proceeding dealing with the subject matter of the Committee process ("Confidential Information"). It is the intention of the undersigned and **[Utility]** that this Declaration and Undertaking apply to all of the undersigned's future participation or service on any Committee.

4. I understand that this Declaration and Undertaking is being made to **[Utility]** at this time. In the event that, in the course of a subsequent Board proceeding dealing with the subject matter of a Committee process, the Board determines that any Confidential Information held by me under this Declaration and Undertaking:

(a) shall be considered to be confidential under the Board's Practice Direction on Confidential Filings, and I file a Declaration and Undertaking pursuant to that Practice Direction, or

(b) shall not be considered by the Board to be confidential and is to be placed on the public record;

this Declaration and Undertaking shall thereafter be null and void with respect to that Confidential Information.

UNDERTAKING

I undertake that:

1. I will use Confidential Information exclusively for duties performed in respect of each Committee process and any subsequent Board proceeding dealing with the subject matter of that Committee process.

2. I will not divulge Confidential Information except to a person granted access by **[Utility]** to such Confidential Information.

3. I will not reproduce, in any manner, Confidential Information without the prior written approval of **[Utility]**. For this purpose, reproducing Confidential Information includes scanning paper copies of Confidential Information, copying the Confidential Information onto a diskette or other machine-readable media and saving the Confidential Information onto a computer system. I understand that I may reproduce a hard copy of electronic data received solely for internal purposes, and I undertake to destroy such copies in accordance with this Declaration and Undertaking. For clarity, this prohibition does not preclude the forwarding of electronic Confidential Information material received from one computer to another for the personal use of the undersigned.

4. I will protect Confidential Information from unauthorized access.

5. I will not use Confidential Information in any commercial application or for any monetary or personal benefit, with the exception of remuneration for my participation on any Committee.

6. I will, promptly following the end of each Committee process or the end of any subsequent Board proceeding dealing with the subject matter of a Committee process, whichever shall be later, or within 10 days after the end of my participation in a Committee process or any subsequent Board proceeding dealing with the subject matter of the Committee process:

(a) return to **[Utility]**, all documents and materials in all media containing Confidential Information, including notes, charts, memoranda, transcripts and submissions based on such Confidential Information; or

(b) destroy such documents and materials and file with **[Utility]** a certification of destruction in the form prescribed by the Board pertaining to the destroyed documents and materials.

For this purpose, the end of any subsequent Board proceeding is the date on which the period for filing a review or appeal of the Board's final order in that proceeding expires or, if a review or appeal is filed, upon issuance of a final decision on the review or appeal from which no further review or appeal can or has been taken.

In respect of those Intervenors that serve on the same Committee for more than one term, the obligation to destroy Confidential Information arises as of the date of the Intervenor's retirement from the Committee.

7. I will inform **[Utility]** immediately of any changes in the facts referred to in this Declaration and Undertaking.

Dated at Toronto, this ____ day of ___________________, 2011.

Signature: ______________________________

Name:

Company/Firm:

Address:

Telephone:

Email:

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